

# 1987 Documents

## IEEE Neural Networks Council

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The IEEE Neural Networks Council became the IEEE Computational Intelligence Society

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UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

Department of Electrical Engineering, FT-10  
Telephone: (206) 543-2150

December 17, 1987

Mr. Colin Johnson  
EE Times  
333 S. State St. Suite V141  
Portland, OR 97034

Dear Mr. Johnson:

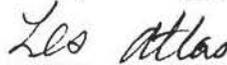
It was my pleasure to talk to you about our research program in neural networks. I have been working in this area since receiving a National Science Foundation Presidential Young Investigator Award in 1985. Our approach has concentrated on problems in temporal pattern classification where humans can currently achieve much better performance than machines. We also have felt (as I pointed out in my talk) that some of the currently popular neural networks have severe practical and analytic problems. Thus, my close collaborator, Prof. Robert Marks, has led an effort to formulate trainable multi-layer networks which have strong analytic guidance and practical advantages. I have enclosed, in addition to the copies of my presentation foils you requested, some papers which represent this new network design.

Our research in artificial neural networks is also supported by a grant from the Washington Technology Center. Robert Marks and I are both Principal Investigators on this grant. In fact, our research program in neural networks is actually part of the Washington Technology Center (yet still within the University of Washington Department of Electrical Engineering).

On March 16-18, 1988, Robert Marks and I will be giving a short course (coordinated by the University of Washington College of Engineering) on Artificial Neural Networks in the San Francisco Bay area. Bernie Widrow has agreed to give a guest lecture at this course. This course is a slightly expanded version of a course we gave last August in Seattle.

I've enjoyed the quality of your past articles on the innovations in artificial neural networks. Please feel free to contact me if you have any more questions and let me add that you always have an open invitation to visit us.

Sincerely and Happy Holidays,



Les Atlas, Asst. Professor  
Phone:(206)545-1315

LA/la-unix  
enc.

cc. Prof. Robert Marks, Dept. of EE  
Prof. Ed Stear, Director Washington Technology Center

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

Interactive Systems Design Laboratory  
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12-19-87

Mike Wang  
Optical Systems Lab  
Dept. of Electrical Engineering  
Texas Tech University  
Lubbock, Texas 79409

Dear Mike,  
Greetings!

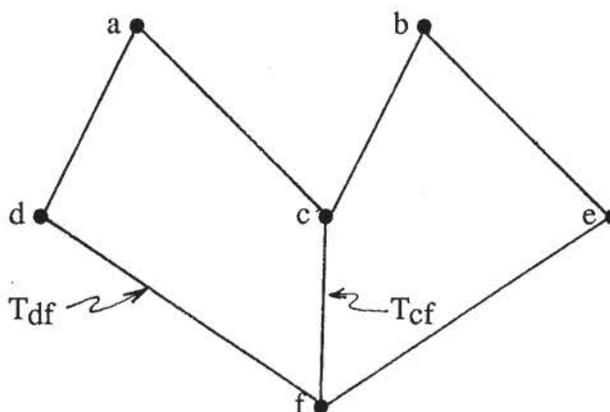
I write in response to your 12-4-87 letter. Let me first explain why I believe there are *hidden* neurons in your model. In backward error propagation neural networks (a tutorial is enclosed), there are three neural layers: the input or clamped layer, the hidden layer and the output or floating level. The hidden layer is a nonlinear function of the input layer. The output is then determined by the hidden layer states and, in some architectures by the input layer also.

In your model, there is also a hidden layer that is a nonlinear function of the input layer. Consider two input neurons, a & b. Assume there is a single output neuron, f. Your hidden neurons have states  $c=ab$ ,  $d=a^2$  and  $e=b^2$ . The neural net looks like:

input:

hidden:

output:



Note, for example, that  $T_{cf} = T_{abf}$  in your notation. One of your models (scheme 3) has the input neurons connected to the output. Another, as shown here, does not. This hidden layer, I believe, should be included in the total neuron count when computing the network's storage capacity.

Here's an example using our alternating projection neural network (APNN). A

preprint is enclosed. The truth table for an exclusive or (XOR) is:

a:	-1	1	-1	1
b:	-1	-1	1	1
f:	1	-1	-1	1

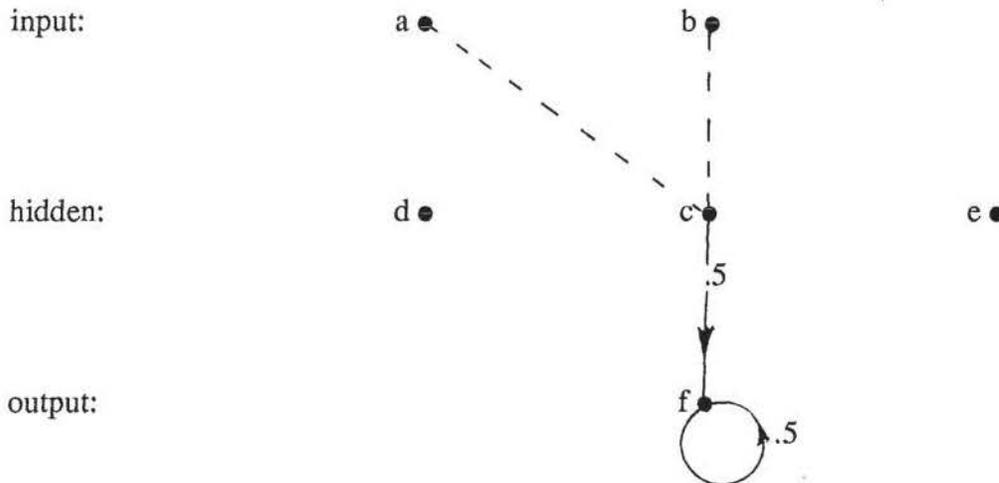
Let's add in the hidden layers also to form the augmented library matrix:

$$\begin{array}{l}
 \text{a:} \\
 \text{b:} \\
 \text{c:} \\
 \text{d:} \\
 \text{e:} \\
 \text{f:}
 \end{array}
 \quad
 F_+ = \begin{bmatrix}
 -1 & 1 & -1 & 1 \\
 -1 & -1 & 1 & 1 \\
 1 & -1 & -1 & 1 \\
 1 & 1 & 1 & 1 \\
 1 & 1 & 1 & 1 \\
 1 & -1 & -1 & 1
 \end{bmatrix}$$

and the interconnect (projection) matrix:

$$\begin{aligned}
 T &= F(F'F)^{-1}F' \\
 &= \begin{bmatrix}
 1 & 0 & 0 & 0 & 0 & 0 \\
 0 & 1 & 0 & 0 & 0 & 0 \\
 0 & 0 & .5 & 0 & 0 & .5 \\
 0 & 0 & 0 & .5 & .5 & 0 \\
 0 & 0 & .5 & 0 & 0 & .5
 \end{bmatrix}
 \end{aligned}$$

The corresponding APNN neural network is:



Only the interconnects to the output are shown because, in the APNN, the input neurons are *clamped*. As a direct result, the hidden neurons are indirectly *clamped*. As you can see, the only non-self interconnect is to neuron c which, from the library matrix, is the result we want. The network iterates to the proper value due to the auto-connect.

I hope this has been helpful to you. Please don't hesitate to call if I can be of further assistance.

Best regards,

A handwritten signature in cursive script, appearing to read "Robert J. Marks II". The signature is fluid and somewhat stylized, with a prominent initial "R" and a long, sweeping underline.

Robert J. Marks II  
Professor

University of Washington Correspondence

INTERDEPARTMENTAL

10-2-87

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TO: Profs. Atlas and Noges

FROM: Bob Marks

SUBJECT: Further Kohonen honoraria

*BAD NEWS*

*enclosure*

University of Washington Correspondence

**INTERDEPARTMENTAL**

The Graduate School AG-10

---

October 1, 1987

Professor Robert J. Marks II  
Department of Electrical Engineering, FT-10

Dear Dr. Marks:

Thank you for your memo regarding the Colloquium of Dr. Kohonen. We are pleased that the Graduate School Research Fund, through the Travel & Honoraria allocation to the Department of Electrical Engineering, will provide a \$300 honorarium for this important seminar.

A total allocation of over \$340,000 has recently been made by the Graduate School to units across campus in support of travel and honoraria during the 1987-89 biennium. This leaves only a small reserve for those departments which did not receive an allocation. We normally would not supplement a department's allocation until it was expended and reserve funds remained at the end of the biennium. My suggestion is that you might consider a joint sponsorship, with both departments providing funds from their individual allocations.

I am sorry that we cannot be of more help and I wish you well.

Sincerely,



Dale E. Johnson  
Associate Dean for Academic  
Programs and Research

cc: Dean Gene Woodruff

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10-1-87

Robert Graham  
Boeing Electronics Co.  
P.O. Box 24969, MS J7-24  
Seattle, WA 98124-6269

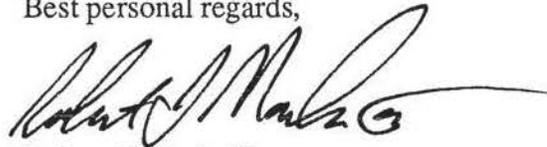
Dear Robert,

Enclosed is the abstract of a talk that Dr. Kohonen is planning to present at the BHTC.  
His CV and a list of publications is also enclosed.

I would appreciate getting a copy of your announcement to publicize to our students.  
Some of us are planning to attend his BHTC talk.

Thank you.

Best personal regards,



Robert J. Marks II  
Professor

*enclosures*

*cc: Profs. Atlas and Noges*

# Self-Organizing Sensory Maps for Pattern Recognition: A Neurocomputer Approach

Teuvo Kohonen

Helsinki University of Technology  
Laboratory of Computer and Information Science  
Rakentajanaukio 2C, SF-02150 Espoo, Finland

## Abstract

A simple but nonetheless effective pattern recognition method is described, in which the probability density functions of pattern classes are represented by a fixed and rather small number of adaptively determined reference vectors, of which the nearest neighbour defines the classification. The values of the reference vectors are determined in a self-organizing process whereafter the decision surfaces constitute very good approximations of those of the Bayes classifier.

Another, more complicated method is motivated by brain theory. One of the purposes of the brain is to form an internal representation of the exterior world. It is suggested that a simple physical-type self-organizing process is able to compress sensory information and to represent its main features in low-dimensional (say 2-D) maps that approximately preserve the metric and topological relations between observations. Examples of such maps are topographic maps of the environment, feature maps of visual and auditory signal spaces, and taxonomic graphs of hierarchically related data, which have been produced by computer simulations. Such maps can be used for effective statistical pattern recognition, and a Phonetic Typewriter which converts continuous speech into text will be referred to as an example.

## Curriculum Vitae

### Teuvo Kalevi Kohonen

Date of Birth: July 11, 1934  
Place of Birth: Lauritsala, Finland  
Citizenship: Finnish  
Address: Residence: Mellstenintie 9 C 2  
SF-02170 Espoo, Finland  
Business: Helsinki University of Technology  
Laboratory of Computer and Information  
Science  
Rakentajanaukio 2 C  
SF-02150 Espoo, Finland

Family: Married, four children  
Education: Diploma Engineer (M.Sc.), Helsinki University of  
Technology, 1957, in Physics ("with honours")  
Licentiate in Technology, Helsinki University of Technology,  
1960, in Physics  
Doctor of Engineering, Helsinki University of Technology,  
1962, in Physics  
D.Eng. Thesis: "Contributions to the Study of Lifetimes of  
Positrons in Solids"

Employment: 1957-59 Teaching Assistant in Physics at the Helsinki  
University of Technology  
1959-62 Research Associate of the Finnish Atomic Energy  
Commission  
1963-65 Assistant Professor in Physics at the Helsinki  
University of Technology  
1965- Professor of Technical Physics (Electronics) at  
the Helsinki University of Technology  
1968-69 On leave as a Visiting Professor at the University  
of Washington, Seattle, Wash.  
1975-78 Appointed as Research Professor of the Academy  
of Finland  
1980-88 "

Academic Societies:

The Finnish Academy of Sciences, Member  
The Finnish Academy of Engineering Sciences, Member  
Representative of Finland in the International Association for  
Pattern Recognition (IAPR), Vice Chairman of IAPR '82/'84  
The Brain Research Society of Finland  
The Pattern Recognition Society of Finland, Honorary  
Member

Areas of Scientific Interest:

Computer and information sciences, in particular the theory  
of associative memory and self-organization. Pattern  
recognition, especially recognition of speech.

Publications: Cf. separate sheet

Prizes: Eemil Aaltonen Prize, 1983  
The Cultural Prize of the Finnish Commercial Television  
(MTV), 1984

Biographical listings:

5000 Personalities of the World (Am. Biograph. Inst.,  
Raleigh)  
International Book of Honour (6000 entries; Am. Biograph.  
Inst., Raleigh)  
Who's Where Among Writers (publishers, New York)  
Longman's Who's Who in Science (Longman Group Ltd.,  
Harlow)  
Marquis Who's Who in Science (Marquis Who's Who, Inc.,  
Chicago)  
International Register of Profiles (Intern. Biograph. Centre,  
Cambridge; in press)  
International Leaders in Achievement (Intern. Biograph.  
Centre, Cambridge; in press)  
+ seven other biographical reference books

**Prof. Teuvo Kohonen**  
Helsinki University of Technology  
Laboratory of Computer and Information Science  
SF-02150 Espoo, Finland

### LIST OF PUBLICATIONS

#### Books:

- T. Kohonen, *Self-Organization and Associative Memory*, Springer-Verlag, Series in Information Sciences, Vol. 8, Berlin - Heidelberg - New York - Tokyo, 1984
- T. Kohonen, *Content-Addressable Memories*, Springer-Verlag, Series in Information Sciences, Vol. 1, Berlin - Heidelberg - New York, 1980, Second ed. 1987; Russian ed.: MIR, Moscow, 1982
- T. Kohonen, *Associative Memory - A System-Theoretical Approach*, Springer-Verlag, Series Communication and Cybernetics, Vol. 17, Berlin - Heidelberg - New York, 1977; 2nd ed. 1978; Russian ed.: MIR, Moscow, 1980; Japanese ed.: Saiensu sha, Tokyo, 1980
- T. Kohonen, *Digital Circuits and Devices*, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1972, 466 p; Polish ed.: Wydawnictwa Naukowo-Techniczne, Warsaw, 1975

#### Papers:

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137. T. Kohonen, Memory Systems for Future Computers, to be published in *Science & Technology in Europe*, ed. N. Calder (Nature & Technology, Scientific Publishers, Maastricht, The Netherlands)
136. T. Kohonen, Content-Addressable Memory, to be published in *Encyclopedia of Computer Science and Technology*, eds. A. Kent and J.G. Williams (Marcel Dekker, Inc., New York, Basel); also to be published in *Encyclopedia of Microcomputers* (Marcel Dekker, Inc., New York, Basel)
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134. T. Kohonen, J. Kangas, K. Torkkola, and O. Ventä, The Otaniemi Speech Recognition System, U.R.S.I./IEEE XII National Convention on Radio Science, Espoo, Finland, October 31, 1986, p. B1.1
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132. T. Kohonen, Dynamically Expanding Context, with Application to the Correction of Symbol Strings in the Recognition of Continuous Speech, Proc. of the Eighth International Conference on Pattern Recognition, Paris, France, October 28-31, 1986, pp. 1148-1151
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129. T. Kohonen, Representation of Sensory Information in Self-Organizing Feature Maps, and Relation of These Maps to Distributed Memory Networks, Proc. of Conference on Computer Simulation in Brain Science, Copenhagen, Denmark, August 20-22, 1986 (Cambridge University Press)

128. T. Kohonen, Self-Organized Sensory Maps and Associative Memory, Proc. of the International Symposium on Physics of Cognitive Processes, Amalfi, Italy, June 16-20, 1986
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126. T. Kohonen, Representation of Sensory Information in Self-Organizing Feature Maps, and Relation of These Maps to Distributed Memory Networks, in Optical and Hybrid Computing, H.H. Szu, ed., SPIE Vol. 634, pp. 248-259 (1987)
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114. T. Kohonen, Oppivien koneiden uusi tuleminen, Sähkö, Vol. 57, No. 8, 1984, pp. 48-51 (in Finnish)
113. T. Kohonen, Automaattisen hahmontunnistuksen näkymät, Seminar on Technology Transfer, The Association of the Employers of the Graphic Industries, January 17-18, 1984 (in Finnish)
112. T. Kohonen, H. Riittinen, E. Reuhkala, and S. Haltsonen, On-Line Recognition of Spoken Words from a Large Vocabulary, Information Sciences 33, 3-30 (1984) (Invited Paper)
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109. T. Kohonen, Self-Organizing Mappings for Two-Dimensional (Visual) Display of High-Dimensional Pattern Spaces, in Proc. 3rd Scandinavian Conference on Image Analysis, July 12-14, 1983, P. Johansen and P.W. Becker (eds.), The Danish Pattern Recognition Society, Copenhagen, Denmark, pp. 35-41

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[  
] Newsletter of the Puget Sound Section  
of the Optical Society of America

EDITOR'S COLUMN

This is the second issue of the newsletter of the Puget Sound Section of the Optical Society of America. The blank between the brackets is the newsletter's name: we don't have one yet. But we're working on it, as the Message from the President shows. The logo on the back of the folded newsletter is from Donald C. O'Shea's text Elements of Modern Design, John Wiley & Sons, 1985, p. 120 Fig. 4.1.

Our October 8 Meeting program features Emil Wolf. The excerpt from Optics News about him was contributed by Aaron Falk, our President-elect.

It is a pleasure to share with you all the official letter of recognition for our Puget Sound section from the Optical Society of America headquarters. The gavel has arrived and was used enthusiastically at the August meeting.

Ted Houk, Editor

Message from the President:

The OSA National Meeting is coming up the week of October 19th in Rochester. At these annual meetings, local sections get together to discuss things. Exactly what, I'm not sure. The high frequency of other travel and commitments to a wife and three children have led me to decide not to attend this gala celebration. Dr. Ted Houk, our esteemed newsletter editor, has agreed to represent our section at the Rochester meeting and report to us the happenings. Thank you Ted.

Shira Broschat, the elected student representative of our local section, pointed out that our menu announcement for the Emil Wolf dinner meeting included pork *lion*. Yes ... it's a misprint. We're having the less exotic dish of pork *loin*. The prospects of having Wolf, lion and mouse at the same dinner, however, remain quite intriguing. Speaking of which ... if our menu offends your dietary traditions, vegetarian dishes are available. Just inform the person from whom you buy the ticket.

This, I believe, will be our last newsletter without a name. We'll decide the name at our next meeting. I personally favor *Sound Optics* because it's a pun with three levels of meaning. *Light Reading* and *Emerald City Optik* are also good. Or how about *Sound Light Reading*? Let's take nominations and vote on it next time we see each other.

Aaron Falk is approaching some superb speakers for our December meeting. We're considering putting a pinch of Christmas in that meeting by having an unorthodox present exchange during the dinner. And no ... I will not be talked into playing Santa Claus.

I must go now. There is a nibble on my line.

Robert J. Marks II

Emil Wolf elected  
OSA honorary member

Emil Wolf, professor of physics and professor of optics at the University of Rochester, has been elected an honorary member of the Society in recognition of his "preeminent service in the advancement of optics." Wolf, who has been involved in the field for nearly 40 years, is known primarily for his work in electro-magnetic theory and physical optics, especially diffraction and the theory of partial coherence.

An OSA fellow and former Society president, Wolf is also the recipient of this year's Max Born Award for works dealing with the theory of partial coherence in the space-frequency domain, scattering and inverse scattering, phase conjugation, radiation, and radiometry.

After completing his studies at the University of Bristol and the University



Emil Wolf

of Edinburgh, Wolf began his career at Cambridge University as a research assistant, then became Max Born's research assistant at the University of Edinburgh. Later, Wolf and Born coauthored *Principles of Optics*, one of the best-known optics textbooks.

In addition to nearly 200 published papers, Wolf is editor of *Progress in Optics*, a series that began in 1961. He is also a member of the Advisory

Editorial Board of *Optics Communications* and the Editorial Board of *Advances in Optoelectronics*.

A native of Prague, Czechoslovakia, Wolf has taught at the University of Rochester since 1961, except for one term as visiting professor at the University of California at Berkeley and another at the University of Toronto. He was recently named the Wilson Professor of Optics at Rochester.

Wolf was the 1977 recipient of the Frederic Ives Medal, OSA's highest award for overall distinction in optics. Beyond honors bestowed by the Society, he received the Franklin Institute's Albert A. Michelson Medal in 1980 and is a fellow of the American Physical Society, the British Institute of Physics, and the Franklin Institute, and an honorary member of the Optical Society of India.

Wolf's election to honorary membership in OSA will be formally acknowledged in a presentation at the Society's annual meeting in Rochester this October.

Student Profile:

Name:	William H. Nicholls
Citizenship:	United States
Areas of research interest:	VLSI Design and Test
Present area of research:	VLSI Design and Test
Degrees obtained:	B.S.E.E., M.S.E.E.
Current degree program:	Ph.D. in E.E., U.W.
Expected date of completion:	December 1988
Future plans or goals:	Research and Development
Favorite novel(s):	Dune et. al, Tolkien trilogy
Favorite movie(s):	Blade Runner, Brewster McCloud
Favorite food(s):	Curried food, lasagna, Thai food
Favorite music:	Folk, classical, rock, punk, Balkan
Favorite city/cities:	Seattle
Hobbies:	Reading, dungeoning, hacking
Languages:	English, Scheme, C
Special skill(s):	PC Wizard
Favorite fantasy:	Design (and drive) the first space car.

University of Colorado at Boulder

National Center for Optoelectronic Computing Systems

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Campus Box 425  
Boulder, Colorado 80309-0425  
(303) 492-1888

July 7, 1987

Dr. Robert J. Marks  
Interactive Systems  
Design Laboratory  
University of Washington  
Seattle, WA 98195

Dear Dr. Marks:

There will be an Air Force Office of Scientific Research/Office of Naval Research supported Workshop on Optical Artificial Intelligence on August 2 - 5, 1987 near Boulder, Colorado.

The attendance is limited to approximately 35 researchers in optics and artificial intelligence and neural networks (see attached tentative list).

Your participation will be extremely useful to this workshop, and the growing field of optical artificial intelligence.

To help cover your expenses, we can refund the registration fee and cover some travel expenses.

Looking forward to your participation at this workshop. Please R.S.V.P. Karen at (303) 492-1137 as soon as possible.

Sincerely yours,

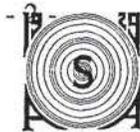
*W. T. Cathey*

W. Thomas Cathey, Director  
National Center for Optoelectronic  
Computing Systems

WTC/km

Encls. invitation list  
description  
registration  
brochure  
airporter sched.

ACOUSTICAL · SOCIETY · OF · AMERICA



"NORTHWEST CHAPTER"

September 14, 1987

Prof. Teuvo Kohonen  
Department of Technical Physics  
Helsinki University of Technology  
SF-02150 Espoo 15, FINLAND

Dear Prof. Kohonen:

On behalf of the Northwest Chapter of the Acoustical Society of America I would like to invite you to be the guest speaker at our meeting on Wednesday, Oct. 21. Our usual meeting agenda includes drinks at 5:30 PM, dinner at 6:15 and the presentation (45 min.- 1hr.) after dinner. It is our policy to cover expenses for drinks and dinner for the speaker and his guest. Also, an honorarium of \$500 will be presented to you by our chapter.

The meeting will be held at a restaurant close to the University of Washington. I will be happy to provide you with directions or transportation to the meeting.

Many of us in the Seattle area have been following your recent work in speech recognition. While you are free to discuss anything you would like at the meeting, I suspect that the audience would be most knowledgeable in speech or other acoustical areas.

In order to prepare our announcement for this meeting, I will need a title and abstract for your presentation. A short biography will also be useful. I will need this information by Nov. 2. My mail address is:

Prof. Les Atlas  
Department of Electrical Engineering, FT-10  
University of Washington  
Seattle, WA 98195  
USA

Please let me know if you have any questions. I can be reached at (206)545-1315. I look forward to meeting you in Seattle next month.

Sincerely,

A handwritten signature in black ink that reads "Les Atlas". The signature is written in a cursive, slightly slanted style.

Les Atlas  
Chair  
NW Chapter ASA

LA/la-unix  
cc: Prof. Endrik Noges  
Prof. Robert Marks

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

9-22-87

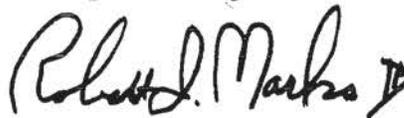
Robert Graham  
Boeing Electronics Co.  
P.O. Box 24969, MS J7-24  
Seattle, WA 98124-6269

Dear Robert,

I write in regard to our conversation concerning the visit of Dr. Kohonen on Oct. 20-21. We will request that he spend one half of a day on Tuesday, Oct. 20th at the BHTC. The honorarium from BHTC for this effort should be no less than \$500.

We also plan to have Dr. Kohonen present a seminar in the Electrical Engineering Department at 3:30 on Wednesday, Oct. 21st. As always, your colleagues at Boeing are welcome to attend. You will be receiving further details in our regular flyer mailings. A third seminar will be given the evening of the 21st at the local section meeting of the Acoustical Society of America.

Best personal regards,



Robert J. Marks II  
Professor

cc: Prof. Atlas and Noges

University of Washington Correspondence

# INTERDEPARTMENTAL

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9-25-87

To: Dean Gene Woodruff  
From: Prof. Robert J. Marks II   
Dept. of Electrical Engineering  
Subject: Honorarium for Dr. Teuvo Kohonen

Our College has the rare opportunity to have a scholar the caliber of Dr. Kohonen visiting our campus next month. He is, without debate, one of the world's foremost experts on artificial associative memories and neural networks and will be well received by the artificial intelligence, neuro-science, computer science and signal processing communities. He has previously done research in our department. Our expenses will be reduced because Prof. Noges, a friend and colleague of Dr. Kohonen's, has generously agreed to have him as a personal house guest. Dr. Kohonen is in the United States from Helsinki University of Technology on other business, so his travel is also paid.

Prof. Robert Clark, our Department's Colloquim Coordinator, has committed \$300 of our GSRF money as an honorarium for Dr. Kohonen. I request that the College contribute an additional \$300. This will put the honorarium at a more appropriate level. Dr. Kohonen's seminar here will afford a rare opportunity for our faculty and graduate students who are doing research into artificial neural systems. He will be here October 20th and 21st.

I can be reached via campus mail (mail stop FT-10) or at 3-6990.

I look forward to your response.

*cc: Profs. Les Atlas, Bob Clark and Endrik Noges  
Sharon Schlittenhard*

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

September 14, 1987

Professor Teuvo Kohonen  
Department of Technical Physics  
Helsinki University of Technology  
SF-02150 Espoo 15, Finland

Dear Teuvo:

I am writing to confirm our invitation to you to participate in a Departmental seminar and a discussion at the Boeing Company. You probably have already heard from Dr. Les Atlas, with a separate invitation to you to give a lecture for the Acoustical Society of America.

A proposed schedule for you as of today is as follows:

Tuesday, October 20

1/2 day at the Boeing Company; 1/2 day visits at Department

Wednesday, October 21

Morning visits at the University of Washington  
3:30 p.m., Electrical Engineering Colloquium  
Evening dinner and lecture at the Acoustical Society of America

I will work out more specific details as the time approaches.

I would like to ask, if at all possible, that you give different talks at the above three occasions. I understand that Dr. Atlas has already requested an abstract for your talk at the Acoustical Society of America. I would like to repeat that request for the Department of Electrical Engineering and for the Boeing Company. In addition, please supply us with an up-to-date curriculum vitae.

The total honorarium for your activities outlined earlier is \$1500.00: \$500.00 from the Acoustical Society of America and \$1,000.00 from the combined sources of the University of Washington and the Boeing Company. We are indeed honored that you, as a world-renowned expert in the area, are willing to share your scholarship with our colleagues, researchers in the Seattle area, and students.

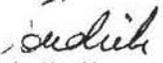
Professor Teuvo Kohonen  
September 14, 1987  
Page 2

I hope that you will be able to arrive in Seattle either Sunday or sometime during Monday so that we will have an opportunity for a social occasion in our home. As I already indicated, Evie and I are inviting you to stay in our home during your visit in Seattle. Please let me know of your arrival time so that we can meet you at the Seattle-Tacoma airport.

In order for us to be able to provide your presentations the publicity they justly deserve, I would like to ask that you send us the abstracts and the curriculum vitae as soon as possible, preferably by the first of October.

We are looking forward to seeing you here in Seattle.

Sincerely,

  
Endrik Noges  
Associate Chair and Professor

EN:ew

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

9-10-87

Dr. John F. Walkup  
Optical Systems Lab  
Dept. of Electrical Engineering  
Texas Tech University  
Lubbock, Texas 49409

Dear John,

I love these laser printers. You can make things

**BIG**

or print them really

small

...but I digress.

I really enjoyed your quadratic neural network writeup and have some definite ideas on the concept.

(Good news) For an alternating projection neural network, the neurons corresponding to the outer product terms, I can show, increase the storage capacity of the network on the order of a square. Such networks can be trained on one pass through the data.

(Bad news) There is bad news for use of quadratic nets using the Hopfield model- type neural nets. Here, doubling the number of neurons (increasing the number of interconnects by a square) *less* than doubles the networks storage capacity asymptotically. I'm not clear, however, what happens in a case like Gile's proposition. That neural network, even with the outer product, seems very Hopfieldish.

I would welcome the opportunity to get together and talk more on the subject. I have no doubt that a day or so together would result in a paper. The merging of our work thusfar in this area comes quite close. We need but putty in the cracks.

Gotta go. I just had a nibble on my line.

Brother,

A handwritten signature in cursive script that reads "Bob" followed by a checkmark.

Robert J. Marks II  
Professor  
*(and all round swell guy)*

cc: Les Atlas

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

Department of Electrical Engineering, FT-10  
Telephone: (206) 543-2150

August 10, 1987

Dr. H. John Caulfield, Head  
Center for Applied Optics  
University of Alabama  
Huntsville, AL 35899

Dear John,

Greetings! It was good to meet with you again at the Gold Lake Workshop. Your high levels of enthusiasm and creativity are inspiring.

Some Items:

1. Attached is the paper by Ochoa et. al. on an optical system to perform optical median filtering. Although the implementation has a similar flavor to your proposal, I think that the bridging of the connection morphology and optical processing is worthwhile.
2. We talked briefly about the difference between synchronous vs. asynchronous operations of neural networks. A preprint of some work done by one of my graduate students in this area is enclosed. I hope you find it of interest.
3. I'll be giving some thoughts to viewing the BAM as a Gerchberg type algorithm.. same with histogram equalization. I'll let you know if anything fruitful results.

Best personal regards,

Robert J. Marks II  
Professor

RJM: dmr

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

August 10, 1987

Dr. W. Thomas Cathey,  
Center for Optoelectronic  
Computing Systems  
Campus Box 425  
University of Colorado  
Boulder, CO 90309-0425

Dear Tom,

Thank you again for your invitation to the Gold Lake Workshop. I had a delightful time and returned home inspired and energetic.

We talked briefly about using neural networks as number crunchers. Although I'm not yet sure this is the calling of neural networks, we have done a bit of work in the area. Attached is a reprint of a related paper. Some other preprints are also enclosed. I hope you find them of interest.

Congratulations again on your center. I have no doubt it will continue to have profound impact on our community.

Best personal regards,

Robert J. Marks, II  
Professor

RJM: dmr

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*Telephone: (206) 543-2150*

August 10, 1987

Dr. Louis Scharf  
Center for Optoelectronic  
Computing Systems  
Campus Box 425  
University of Colorado  
Boulder, CO 80309-0425

Dear Louis,

It was good to have met you at the Gold Lake Workshop. The activity in your new Center is very exciting.

We talked briefly concerning the performance of the composite matched filter vs. the conventional matched filter. Enclosed is a preprint of a paper to appear in A0 concerning this. Four other reprints on related topics are also enclosed. I hope you find them of interest.

Please let me know if you have any thoughts in this direction you wish to bounce around. I hope to see you soon.

Sincerely,



Robert J. Marks II  
Professor

RJM: dmr

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

September 2, 1981

Dr. Henry Stark  
ECSE  
RPI  
Troy, NY 12180

Dear Henry,

I was delighted with our meeting in Quebec. I remain highly impressed with the quality and significance of your work. One of my Ph.D. students, by the way, was tested on some of your polar sampling theorem papers in his General exam a few months ago.

Enclosed is probably more than you want to know about our work. I hope you find some of it is useful. Let me know especially if you have any neat ideas about POCS and neural networks.

Best personal regards,

Robert J. Marks II  
Professor

RJM/dmr  
Enclosures

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

June 24, 1987

Dr. Clayton C. Walker  
NUSC, Code 10  
New London, Conn. 06320

Dear Dr. Walker:

It was good to have spoken to you about our common interest in neural networks. Recently, a good tutorial has been published in IEEE ASSP Magazine on neural networks for pattern classification (April '87). We are presently working on an invited tutorial for neural networks that attacks combinatorial problems. I will send you a preprint when it is completed. I also enclose a flyer for our upcoming short course and a preprint of some recent papers. I hope they prove useful to you.

Sincerely,

Robert J. Marks II  
Professor

RJM/drm  
Enc.

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

February 18, 1987

Mr. James Douglas  
M.S. 7L-47  
P.O. Box 24346  
Boeing Computer Services  
Seattle, WA 98124

Dear James,

Thank you again for your superb talk on "Content Addressable Memory with Neural Nets" that you presented in our department on February 3, 1987. The response to your enthusiastic presentation was most favorable. We deeply appreciate your participation and hope you will present other seminars on your research results here in the future.

Sincerely,

Robert J. Marks II

RJM/dmr  
cc: Les Atlas

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering FT-10*  
*Telephone: (206) 543-2150*

January 21, 1987

Dziem Nguyen and Fred Holt  
Boeing Electronics Co.  
P.O. Box 3707, MS 7J-24  
Seattle, WA 98124-2207

Dear Dziem and Fred,

Thank you again for your superb talk on "Continuous Level Neural Net Implementation using Stochastic Processing" that you presented in our department on Jan. 20, 1987. The response to your enthusiastic presentation was most favorable. We deeply appreciate your participation and hope you will present other seminars on your research results here in the future.

Sincerely,

Robert J. Marks II

RJM/dm  
cc: Rob Graham, Boeing HTC



מכון ויצמן למדע  
THE WEIZMANN INSTITUTE OF SCIENCE  
REHOVOT · ISRAEL רחובות · ישראל

DEPARTMENT OF ELECTRONICS

המחלקה לאלקטרוניקה

Prof. I. Glaser

February 15th, 1987

*BITNET, EARNET:* FEGLASER at WEIZMANN  
*ARPAnet:* feglaser%weizmann.BITNET@wiscvm.wisc.edu  
*CSnet:* feglaser%weizmann.BITNET@csnet-relay

Prof. Robert J. Marks II  
University of Washington  
EE Department, FT-1  
Seattle, WA 98195  
U.S.A.

Dear Prof. Marks,

Following the Gordon Conference on **Holography and Optical Information Processing** last January, I am trying to compile a **list of computer-network addresses** of people who work in this field and would like to communicate via their computer. Personally, I have found computer networking very useful, particularly for international communication where telephone calls are often inappropriate and paper mail often too slow. Also, it is possible to set distribution lists on computer networks so it is easy to send announcements etc. to a large group of people.

If you are on any computer network and you would like to have your name added to the list I am preparing, please let me have your computer address. Better yet, try to send me a message from your computer (see my network addresses above).

I would also appreciate if you will forward a copy of this letter to other scientists who work in this field.

Of course, you will receive a copy of this list once I have verified all the entries in it. This list would be used for "academic" scientific and technical announcements and personal communication only.

Thank you for your cooperation

Most Sincerely Yours

Shelly Glaser

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering FT-10*  
*Telephone: (206) 543-2150*

January 21, 1987

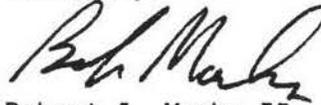
Mr. James Douglas  
Boeing Computer Services  
M.S. 7L-47  
P.O. Box 24346  
Seattle, WA 98124

Dear James:

We are looking forward to your presentation on content addressable memories. A flyer announcing your talk is enclosed.

To make your visit more convenient, a parking permit is enclosed for Feb. 3, 1987. In the unlikely event the lot is full, simply return to the gate for reassignment.

Sincerely,



Robert J. Marks II

RJM/dm  
Enclosure

University of Washington Correspondence

# INTERDEPARTMENTAL

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DEPARTMENT OF ELECTRICAL ENGINEERING FT-10

DATE: November 3, 1986  
TO: Edw'n B. Stear, Washington Technology Center, FH-10  
FROM: Les Atlas  
SUBJECT: Clifford Lau's Interest in Artificial Neural Computers

After looking over Dr. Lau's Research "Initiative in Electronic Neural Computing Architectures", it seems clear that our current work in this area is extremely close to the issues that he brought up. I am curious as to whether our best strategy would be to propose a joint study with BECo or if we would stand a better chance on our own. I see advantages to each approach and I'd like to discuss this with you (and possibly also with Clifford Lau).

LA:jt  
cc: Robert Marks

THE PENNSYLVANIA STATE UNIVERSITY

121 ELECTRICAL ENGINEERING EAST BUILDING  
UNIVERSITY PARK, PENNSYLVANIA 16802

College of Engineering  
Department of Electrical Engineering

November 7, 1986

Area Code 814  
865-7667

Professor Robert J. Marks II  
Department of Electrical Engr.  
University of Washington  
Seattle, Washington 98195

Dear Bob:

It was very nice to see you again at the Boeing Workshop. As always, I enjoyed your brilliant presentation.

Thank you for sending me some of your reprints and ~~our~~ extensive copies of your cartoons. Bob, you are a very talented guy. I enjoyed your drawings very much and decided to send them to my daughter, who is majoring in architecture at Carnegie Mellon University.

I have written a letter to John Wiley Publishing Co. asking them to send you a copy of my recent book on "White Light Optical Signal Processing". In this book you will find a few simple colorful experiments that your students may be interested in. I have also enclosed some of our recent papers for your review.

Thanks again for your cartoons, and hope that you would visit our Electro#Optics Laboratory at Penn State.

Best regards,

  
Francis T.S. Yu  
Evan Pugh Professor of  
Electrical Engr. and  
Director of Center for  
Electro#Optics Research

FTSY/kjm

THE PENNSYLVANIA STATE UNIVERSITY

121 ELECTRICAL ENGINEERING EAST BUILDING  
UNIVERSITY PARK, PENNSYLVANIA 16802

College of Engineering  
Department of Electrical Engineering

November 7, 1986

Area Code 814  
865-7667

Miss Beatrice Shube  
Editor  
Wiley-Interscience Division  
John Wiley & Sons, Inc.  
605 Third Avenue  
New York, NY 10158

Dear Miss Shube:

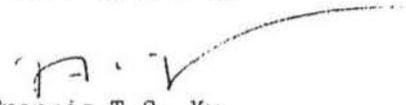
I am writing to request that you would send a copy of my book on "White-Light Optical Signal Processing" to Professor Robert J. Marks at the University of Washington. Dr. Marks is a very prominent professor in the Electro-Optics area in the Electrical Engineering Department. I have known Dr. Marks and his work for so many years.

His address is

Professor Robert J. Marks II  
Electrical Engr. Dept.  
University of Washington  
Seattle, Washington 98195

I would appreciate very much if this request would be granted. Thank you and hope to see you again in the next optical conference.

Sincerely yours,

  
Francis T.S. Yu  
Evan Pugh Professor of  
Electrical Engr.

FTSY/kjm

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering FT-10*  
*Telephone: (206) 543-2150*

October 24, 1986

Dr. Nabil H. Farhat  
Moore School of Electrical Engineering  
33rd and Walnut Streets  
Philadelphia, PA 19174

Dear Nabil:

Thank you for agreeing to present a paper on your neural net work at the 1987 International Symposium on Circuits and Systems. The special session, entitled "Artificial Neural Systems Analysis and Applications", presently consists of six invited papers of top researchers (including yourself) and one contributed paper.

Your presentation will be approximately 30 minutes in duration. I will let you know the time and location of the session as soon as it is scheduled. There will also be a conference proceedings. Although submission is optional I hope you find time to do so. Manuscripts are due on January 23 typed on supplied mats.

Thanks for agreeing to participate! I deeply appreciate your involvement and look forward to seeing you again.

Best personal regards,

Robert J. Marks II  
Associate Professor

RJM:jt  
cc: Les Atlas, Session Co-Chair

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

*Department of Electrical Engineering, FT-10*  
*Telephone: (206) 543-2150*

October 13, 1986

Dr. Theodore L. Houk  
Boeing Aerospace Company  
P.O. Box 3999, MS 87-50  
Seattle, WA 98124-2499

Dear Ted,

Thank you very much for your seminar "Optical Implementation of Hopfield Networks" which you gave here last Tuesday. I believe you broke a box office record—never have I seen such a large number of graduate students at one of our ISDL seminars. I heard many positive comments after the seminar concerning the clarity and quality of your talk. I certainly agree.

Thank you for speaking.

Sincerely,

Robert J. Marks II  
Associate Professor

RJM/dm

June 18, 1985

Mr. Bill Beall  
Mail Stop R1-17  
Intersil  
10600 Ridgeview Ct.  
Cupertino, CA 95014

Dear Bill,

It was a pleasure to meet you yesterday. I enjoyed my conversations with you and your associates and I also feel that our meeting was fruitful. The idea of a chip design which has underpinnings in concepts like the Hopfield model fits in very well with my National Science Foundation Award. The industrial matching funds were given mainly for work in developing signal processing algorithms and architectures, where the developed ideas are inspired by neural processing.

Most of my current research which relates to the Hopfield model is in close collaboration with Prof. Bob Marks. If Intersil (and/or General Electric) is interested in funding a grant or contract in this area it would probably be appropriate for Prof. Bob Marks to be included as a co-investigator. In case you need the extra information I have enclosed his curriculum vitae.

Also enclosed are the receipts from my air fare and car rental. Again, it was a pleasure meeting you and please give my regards to Jim and Norm.

Sincerely,



Les Atlas  
phone:(206)545-1315

LA/la-unix  
enc.(3)