In Workflow

1. **REGISTRAR**
2. **Dept 18**
3. **SOCR**
4. CUP
5. COC
6. FPC
7. Academic Council
8. Faculty

Approval Path

1. Thu, 21 Feb 2019 21:02:05 GMT
   Jennifer Donath (jconnoll): for REGISTRAR
2. Fri, 22 Feb 2019 12:32:16 GMT
   Barbara Peskin (bpeskin): for Dept 18

New Program Proposal

Date Submitted:Fri, 18 Jan 2019 18:49:21 GMT

Viewing:**SB-6-9 : Bachelor of Science in Computation and Cognition (Course 6-9)**

Last edit:Thu, 28 Feb 2019 20:17:31 GMT

Changes proposed by: fee

Is this a substantial revision?

No

Sponsor(s)/Author(s)

Name	E-mail	Phone
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Michale Fee	fee@mit.edu	617-230-5661

Effective Catalog
2019 - 2020

Academic Level
Undergraduate

Program Type
Degree

Degree
Bachelor of Science (SB)

Name of Program
Bachelor of Science in Computation and Cognition (Course 6-9)

Name for Diploma
Bachelor of Science in Computation and Cognition

Administrative Department
Electrical Engineering and Computer Science (6)

Is this program Interdisciplinary?

Yes

Identify all participating academic departments

Department(s)
Electrical Engineering and Computer Science (6)
Brain and Cognitive Sciences (9)

Describe the interdisciplinary construct of the program and the rationale for designing it as such.

The intellectual domains covered by EECS and BCS are already deeply intertwined at the level of faculty, students, and the undergraduate curricula. There are developing intellectual synergies already in the MIT community;CSAIL, Intelligence Quest, School of Computing. Many BCS faculty could be faculty in EECS, and vice-versa. Furthermore, many BCS undergraduate subjects already have more representation from Course 6 students than Course 9 students. The proposed major recognizes an already existing population of faculty and students with a strong interest in this emerging interdisciplinary intellectual area.

Describe the review procedure that you will follow for this program. At a minimum, a review must be conducted every five years.

A review of the program will be conducted after the first and second year, and every five years thereafter.

Course Designation
6-9

Is this a program that is or will be accredited?

No

Explain the educational rationale for the program and its context with respect to the evolving intellectual trends in the relevant field(s). Identify any alternatives you may have considered and how they measured up to your educational objectives.

A new joint degree program, spanning Course 6 and 9, would provide students with outstanding preparation for research and development in the science and engineering of intelligent systems. The problem of intelligence – how the brain produces intelligent behavior and how it can be replicated in machines – is one of the greatest engineering and scientific challenges of our time. The fields of neuroscience and computer science are complementary and interacting. Transformative advances in machine intelligence will require an understanding of the mechanisms of the human mind and brain in engineering terms. Students with combined background are attractive in academia and industry, to companies working in this area—Google, DeepMind, Facebook, GE, etc. The proposed program provides students with access to foundational and advanced material in electrical engineering and computer science, as well as in the architecture, circuits, and physiology of the brain, and computational approaches to cognition and intelligence.

Describe the professional demand for this program and your general expectations regarding student enrollment in each of its first five years of operation.

Based on a web-based survey of undergraduates taking existing 6-9 related subjects, we anticipate that as many as 50-100 students per year may enroll in the new 6-9 major.

Identify any existing MIT programs whose enrollment could potentially be affected by the availability of this program. Describe the consultation process you have followed in reaching out to the departments or academic units and faculty responsible for these programs. How is this proposed program unique from these other programs?

The existence of the 6-9 major may somewhat reduce enrollment in the Course 9 program. (New enrollment of students Course 9 major in 2018 was 18 students.) However, we anticipate that enrollment in Course 9 subjects will substantially increase as a result of the new major.

Additional resources needed to implement this proposal and plans for confirming such resources, including any indirect effects on existing programs.

Resource categories:
Teaching assistants

Describe additional teaching assistant needs
We anticipate a substantial increase in enrollment in a number of Course 9 subjects, including 9.40 (Introduction to Neural Computation) and 9.17 (Neural Systems Laboratory). We anticipate that enrollment in these subjects could double as a result of the new major, producing additional demand for teaching support.

Describe the program, including its structure and coherence, its educational objectives, and any other relevant aspects of the overall educational experience. If the sponsoring entity does not currently offer this type of program (degree or minor), include the rationale for establishing a program within the unit.

There is tremendous interest among Course 6 students in the emerging fields of human and machine intelligence and neural systems engineering. These fields require expertise in particular subsets of topics of Computer Science, Electrical Engineering and Brain and Cognitive Sciences. The proposed 6-9 major provides a more efficient pathway for students to gain this expertise than do combinations of Course 6 and Course 9 majors and minors.

Does this proposal include any non-residential components?

No

Please describe how any new or revised subjects impact this proposal.

N/A

Does the program include any required or recommended subjects that are offered by other departments?

Yes

List any required or recommended subjects in this program that are offered by other departments. Describe the consultations that have taken place with the department responsible for each subject and the conclusions that have been reached regarding potential impact on enrollments.

Department Code	Subject(s)	Consultations undertaken	Potential impact on enrollments	Rationale
18	18.06	Yes- Letter from Course 18 DH Goemans submitted	Already widely taken by Course 6 students. Impact of 6-9 major expected to be minimal.	Linear algebra is an important intellectual underpinning of the major

Department Code	Subject(s)	Consultations undertaken	Potential impact on enrollments	Rationale
18	18.03	Yes- Letter from Course 18 DH Goemans submitted	Already widely taken by Course 6 students. Impact of 6-9 major expected to be minimal.	Content in 18.03 is an important intellectual underpinning of the major

If there are proposed subjects in this program offered by other departments, describe the consultations that have taken place with the department responsible for each subject and the conclusions that have been reached regarding potential impact on enrollments.

For the subjects listed above, describe the resource implications for those units. Summarize how these resource issues will be addressed, and describe the consultation process you followed with the departments and faculty who are responsible for these subjects.

It is unlikely that the introduction of the 6-9 major will substantially increase enrollment in 18.03 or 18.06.

Based on current policy, students may not pursue a second major in the same area as their primary major. Specify any majors that will be disallowed for students to combine as a double major with this program.

Any Course 6-affiliated major or Course 9 major

Based on current policy, students may not pursue a minor in the same area as their major(s). Specify any minors that will be disallowed for students who pursue this major.

Computer Science minor and BCS minor

Degree Chart (published in Catalog)

General Institute Requirements (GIRs)

The General Institute Requirements include a Communication Requirement that is integrated into both the HASS Requirement and the requirements of each major; see details below.

Summary of Subject Requirements	Subjects
Science Requirement	6
Humanities, Arts, and Social Sciences (HASS) Requirement [two subjects can be satisfied by9.46and9.85in the Departmental Program]; at least two of these subjects must be designated as communication-intensive (CI-H) to fulfill the Communication Requirement.	8
Restricted Electives in Science and Technology (REST) Requirement [can be satisfied by9.01and6.042[J],18.03, or18.06in the Departmental Program]	2
Laboratory Requirement (12 units) [can be satisfied by a laboratory in the Departmental Program]	1
Total GIR Subjects Required for SB Degree	**17**
Physical Education Requirement	
Swimming requirement, plus four physical education courses for eight points.	

Departmental Program

Choose at least two subjects in the major that are designated as communication-intensive (CI-M) to fulfill the Communication Requirement.

Required Subjects		Units
6.0001	Introduction to Computer Science Programming in Python	6
9.01	Introduction to Neuroscience	12

Select one of the following:		12
6.042[J]	Mathematics for Computer Science	
18.03	Differential Equations	
18.06	Linear Algebra	
Select one of the following:		12
6.008	Introduction to Inference	
9.07	Statistics for Brain and Cognitive Science[1]	
6.041A & 6.041B	Introduction to Probability I and Introduction to Probability II	
EECS Program Subjects		
6.036	Introduction to Machine Learning[1]	12
6.003	Signals and Systems	12
or 6.034	Artificial Intelligence	
Select two of the following:		24
6.002	Circuits and Electronics	
6.006	Introduction to Algorithms	
6.009	Fundamentals of Programming	
BCS Program Subjects		
Brain Systems/Neurophysiology		
Select one of the following:		12
9.09[J]	Cellular and Molecular Neurobiology	
9.13	The Human Brain	
9.18[J]	Developmental Neurobiology	
9.21[J]	Cellular Neurophysiology and Computing	
9.35	Perception	
9.40	Introduction to Neural Computation[1]	
Computation and Cognition		
Select one of the following:		12
9.19	Computational Psycholinguistics[1]	
9.49	Neural Circuits for Cognition	
9.53	Emergent Computations Within Distributed Neural Circuits	
9.66[J]	Computational Cognitive Science	
9.85	Infant and Early Childhood Cognition (CI-M)[1]	
Program Electives		
One subject from the BCS/EECS Joint Electives list		12
One subject from the BCS Electives or BCS/EECS Joint Electives list		9-12
Laboratory		
One subject from the Laboratory Subjects list		12
Advanced Undergraduate Project		
Select one of the following:		9-18
6.UAR	Seminar in Undergraduate Advanced Research (12 units, CI-M)	
6.UAT	Oral Communication (CI-M)	
9.41	Research and Communication in Neuroscience and Cognitive Science (CI-M)	
9.58	Subject 9.58 Not Found (CI-M)	
Units in Major		159-168
Unrestricted Electives		48-81
Units in Major That Also Satisfy the GIRs		(36-60)
Total Units Beyond the GIRs Required for SB Degree		180

The units for any subject that counts as one of the 17 GIR subjects cannot also be counted as units required beyond the GIRs.

[1] *Subject has prerequisites that are outside of the program.*
[2] *Subjects that also appear in one of the electives lists can count as either a BCS Program Subject or a Program Elective, but not both.*

BCS/EECS Joint Electives[1]

6.027[J]	Biomolecular Feedback Systems	12
6.034	Artificial Intelligence	12
6.141[J]	Robotics: Science and Systems	12
6.801	Machine Vision	12
6.803	The Human Intelligence Enterprise	12
6.806	Advanced Natural Language Processing[2]	12
6.819	Advances in Computer Vision[2]	12
9.19	Computational Psycholinguistics	12
9.21[J]	Cellular Neurophysiology and Computing[2]	12
9.35	Perception	12
9.40	Introduction to Neural Computation	12
9.49	Neural Circuits for Cognition	12
9.66[J]	Computational Cognitive Science	12

BCS Electives[1]

9.09[J]	Cellular and Molecular Neurobiology	12
9.13	The Human Brain	12
9.18[J]	Developmental Neurobiology	12
9.24	Disorders and Diseases of the Nervous System[2]	12
9.26[J]	Principles and Applications of Genetic Engineering for Biotechnology and Neuroscience[2]	12
9.42	The Brain and Its Interface with the Body[2]	12
9.46	Neuroscience of Morality[2]	12
9.53	Emergent Computations Within Distributed Neural Circuits	12
9.85	Infant and Early Childhood Cognition[2]	12

Laboratory Subjects

6.101	Introductory Analog Electronics Laboratory (CI-M)	12
6.111	Introductory Digital Systems Laboratory	12
6.115	Microcomputer Project Laboratory (CI-M)	12
6.129[J]	Biological Circuit Engineering Laboratory (CI-M)	12
6.141[J]	Robotics: Science and Systems (CI-M)	12
6.161	Modern Optics Project Laboratory (CI-M)	12
6.182	Psychoacoustics Project Laboratory (CI-M)	12
9.17	Systems Neuroscience Laboratory (CI-M)	12
9.59[J]	Laboratory in Psycholinguistics (CI-M)	12
9.60	Machine-Motivated Human Vision (CI-M)[2]	12

[1] *Subjects that also appear in the list of BCS Program Subjects can count as either a BCS Program Subject or a Program Elective, but not both.*
[2] *Subject has prerequisites that are outside of the program.*

Program narrative to be published in the Catalog

The Department of Electrical Engineering and Computer Science and the Department of Brain and Cognitive Sciences offer a joint curriculum leading to a Bachelor of Science in Computation and Cognition that focuses on the emerging field of computational and engineering approaches to brain science, cognition and machine intelligence. The curriculum provides flexibility to accommodate students with a wide diversity of interests in this area—from biologically-inspired approaches to artificial intelligence, to reverse engineering circuits in the brain. This joint program prepares students for careers that include advanced applications of artificial intelligence and machine learning, as well as further graduate study in systems and cognitive neuroscience. Students in the program are full members of both departments, with one academic advisor from each department.

Identify the core faculty who will be responsible for the development and supervision of the program, including intellectual content, curriculum development, advising, and degree recommendations.

The program will be administered by an oversight committee of faculty and administrative officers appointed jointly by the Heads of EECS and BCS. The joint oversight committee will be responsible for development and evolution of degree requirements, and for recommending degree candidates to the Registrar. Materials describing the program will be available in the Undergraduate Offices of EECS and BCS. The joint committee will be responsible for coordinating effective administration and for building appropriate bridges to assure that the two Undergraduate Offices work together effectively.

The joint oversight committee will initially include the following members (with nominal appointments of three years): Dennis Freeman (EECS), Polina Golland (EECS), Leslie Kaelbling (EECS), Michale Fee (BCS), Josh Tennenbaum (BCS), Tommy Poggio (BCS).

Describe the academic and advising infrastructure for the program.

Students will have two academic advisors, a primary advisor from BCS and a secondary advisor from EECS. Both advisors will have registration signature authority. Students are expected to meet with one of their two advisors at least once per semester to keep all parties apprised of issues and progress, and to continuously update their career plans at MIT and beyond. Each department will appoint an administrative point person to assist Course 6-9 majors, especially to guide them to relevant departmental resources and assist with faculty contacts in both departments. Faculty advisors will be assigned by the administrative point person, accommodating any specific advising requests made by students.

We expect that BCS faculty will provide most of the academic advising for students in the program. The administrative point persons in each department will coordinate to ensure clarity and uniformity among BCS and EECS advisors regarding program requirements.

Summarize any long-term plans for further developing the curriculum and/or expanding student enrollment beyond the initial years of operation.

The joint oversight committee will consider further development of the degree program, including the development of new subjects, on at least an annual basis.

Questions for Subcommittee of the Communication Requirement (SOCR)

Describe the general content, objectives, and structure of the communication component of the proposed program.

CI-M subjects are available in two broad categories of program requirements:
1) A list of Advanced Undergraduate Projects, which contains 4 CI-M subjects

2) A list of Approved 6 or 9 Laboratory subjects, which includes 10 Institute Lab subjects, 9 of which are CI-M

List the number and title of all the CI-M subjects in the program proposal. If more than two subjects are listed, identify any subjects that are expressly required in the degree program and illustrate the subject options that satisfy the communication portion of the degree program.

Advanced Undergraduate Projects Subjects (all CI-M)
6.UAR Seminar in Undergraduate Advanced Research (CI-M) 12
6.UAT Oral Communication (CI-M) 9
9.41 Research and Communication in Neuroscience and Cognitive Science (CI-M) 18
9.58 EECS/BCS Project Based Subject (CI-M, Currently under development) 12

Approved 6-9 Laboratory Subjects that are also CI-M
9.17 Systems Neuroscience Laboratory (CI-M) 12
9.59[J] Laboratory in Psycholinguistics (CI-M) 12
9.60 Machine-Motivated Human Vision (CI-M) 12
6.101 Introductory Analog Electronics Laboratory (CI-M) 12
6.115 Microcomputer Project Laboratory (CI-M) 12
6.129[J] Biological Circuit Engineering Laboratory (CI-M) 12
6.141[J] Robotics: Science and Systems (CI-M) 12
6.161 Modern Optics Project Laboratory (CI-M) 12
6.182 Psychoacoustics Project Laboratory (CI-M) 12

Approved BCS Electives that are also CI-M
9.46 Neuroscience of Morality (CI-M) 12
9.85 Infant and Early Childhood Cognition (CI-M) 12

Describe how the CI-M program will provide a balance of instruction and practice in oral and written communication across the two-subject sequence.

Available CI-M subjects include a mix of those focused on written and oral modes of communication. We have not yet incorporated any two-subject CIM sequences.

If any CI-M subject is offered by another department, attach a letter of support from the head of that department. (For program revisions, letters are only needed for subjects being added to the program.)

Questions for Committee on the Undergraduate Program (CUP)

Identify the core faculty who will be responsible for the day-to-day operation of the program, and of any broader advisory group that may be required to provide ongoing oversight and assure continuity over time.

The joint oversight committee (described above) will also be responsible for day-to-day operation of the program. They will work closely with the Education Officers and Undergraduate Officers of both EECS and BCS to make sure that students' questions and petitions are addressed in a timely fashion.

The joint oversight committee will also report annually to the Departmental Leadership Groups of EECS and BCS to ensure that the joint program is well integrated with other programs in these units and to assure continuity over time.

Describe the plan to oversee, monitor, and evaluate the program. Interdisciplinary and joint programs must identify a primary academic unit through which the program will be administered. At a minimum, a review must be conducted every five years.

We anticipate that graduates of the proposed program will be well positioned for careers in two rapidly emerging fields: 1) the science and engineering of computational approaches to cognition and intelligence, and 2) computational approaches to understanding the architecture, circuits and physiology of the brain. We will monitor industrial, academic, and medical career interest in our students as well as our students' placement and career advancement after graduation.

We will track student enrollment as one quantitative measure of the success of the program. We anticipate approximately 40-50 students to join the new program each year. If enrollment is significantly lower, we will survey students and convene focus groups to understand why.

We will track student placement as a second measure of success of the program. Our expectation is that graduates of the new joint program will be extremely attractive to companies working in the area of machine intelligence (Google, IBM, DeepMind, Facebook, GE, etc), and will be highly competitive in graduate programs in the brain and cognitive sciences.

Additional information
2/20/19- Changed placeholder number 9.PR to 9.58, the proposed new project subject and CI-M. Revised contents of the following fields in response to the CUP's questions:

-"Identify the core faculty who will be responsible for the development and supervision of the program,..."
-"Describe the academic and advising infrastructure for the program."
-"Summarize any long-term plans for further developing the curriculum..."
-"Identify the core faculty who will be responsible for the day-to-day operation of the program..."
-"Describe the plan to oversee, monitor, and evaluate the program..."

Attachments

Letters of Support
DiCarlo letter - SB in Computation and Cognition 20190221.pdf
course6-9support from Course 18.pdf
EECS Endorsement of 6-9.pdf
SoE endorsement of 6-9.pdf
Sipser letter - SB in Computation and Cognition 22219.pdf

Roadmaps
6-9 revision 0118[2].pdf
RoadMap6-9 v4 _fee.docx
Course 6-9 Roadmap mockup-JCD 20190128.docx

Reviewer Comments
Jennifer Donath (jconnoll) (Fri, 22 Feb 2019 12:43:15 GMT): Uploaded BCS DH J. DiCarlo letter of support.
Jennifer Donath (jconnoll) (Mon, 25 Feb 2019 15:31:01 GMT): Uploaded letters of support from EECS DH Ozdaglar, SoS Dean Sipser, Course 18 DH Goemans.
Jennifer Donath (jconnoll) (Mon, 25 Feb 2019 15:31:57 GMT): On 2/21/19, updated name of program from "Human and Machine Intelligence" to "Computation and Cognition."
Jennifer Donath (jconnoll) (Wed, 27 Feb 2019 22:06:19 GMT):-Uploaded letter of support from SoE Dean Chandrakasan. -Under the question "List any required or recommended subjects in this program that are offered by other departments," add 18.03, which has always been on the degree chart but was not listed in response to the question. Michel Goemans' letter of support refers to both 18.03 and 18.06. -Add 9.49 to BCS/EECS Joint Electives, and add 9.13 and 9.53 to BCS Electives.

brain+cognitive sciences
Massachusetts Institute of Technology
43 Vassar Street, 46-2005, Cambridge, MA 02139
www.mit.edu/bcs

James J. DiCarlo, MD, PhD
Peter de Florez Professor of Neuroscience
Head, Dept. of Brain and Cognitive Sciences
Investigator, McGovern Institute

P: 617.324.5399
F: 617.258.9216
E: dicarlo.bcs@mit.edu

February 21, 19

Re: New Bachelor of Science Degree in Computation and Cognition - SB-6-9

Dear Committee on the Undergraduate Program,

I write this letter in the strongest possible support of the proposed undergraduate joint major (SB-6-9) between the Department of Brain and Cognitive Sciences and the Department of Electrical Engineering and Computer Science. The new joint 6-9 major fills an educational need at the intersection of cognitive science, neuroscience, and computer science. This area represents a dynamic new field of research that is of great interest to faculty and students throughout the Institute, and makes deep connections to the Quest for Intelligence and the new College of Computing. We anticipate strong undergraduate interest in this new major.

We envision the new 6-9 joint degree as an equal partnership between the Brain and Cognitive Sciences and EECS departments, with students in the program being full members of both departments, with academic advisors in each. Such an organization will further encourage the development of new courses jointly taught by faculty in both departments, and may even stimulate cross-fertilization of research ventures.

The Department of Brain and Cognitive Sciences is fully committed to the success of the joint degree program and will contribute equally with the EECS Department to provide the necessary resources for administration of the program and the development and teaching of joint courses, including teaching assistant resources. In addition, BCS-affiliated faculty will serve as primary advisors to students in the program.

The BCS faculty strongly support this new program and look forward to working with their EECS counterparts to make this new joint major a success.

Sincerely,

James J. DiCarlo M.D., Ph.D.
Peter de Florez Professor of Neuroscience
Head, Department of Brain and Cognitive Sciences
Investigator, McGovern Institute for Brain Research
Massachusetts Institute of Technology

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Michel X. Goemans, *Department Head*
Department of Mathematics
77 Massachusetts Ave., Building 4-174
Cambridge, MA 02139-4307
head@math.mit.edu

February 22, 2019

Committee on the Undergraduate Program (CUP)

Dear CUP members:

The Mathematics Department is happy to support the proposal for the new Course 6-9 Bachelor of Science in Computation and Cognition. We recognize that this program may have implications for 18.03 and 18.06 enrollments, but we do not expect this effect to be large – many students in these areas are already taking these subjects -- and we welcome potential 6-9 majors to the classes.

Please feel free to contact me if you need further information.

Sincerely,

Goemans

Michel X Goemans
Department Head
Department of Mathematics, MIT

MIT EECS
ELECTRICAL ENGINEERING
AND COMPUTER SCIENCE

Asu Ozdaglar, Department Head, EECS
Distinguished Professor of Engineering
Massachusetts Institute of Technology
77 Massachusetts Avenue, Rm. 38-403
Cambridge, MA 02139-4307

Phone 617.253.4607
Fax 617.253.0572
Email asuman@mit.edu
http://web.mit.edu/asuman/www/

February 22, 2019

Dear Colleagues,

I am writing in strong support of the proposed undergraduate joint major to be offered by the Department of Electrical Engineering and Computer Science and the Department of Brain and Cognitive Sciences. The new joint major in 6-9 builds on an already strong relation between our two departments as well as Institute-wide enthusiasm for initiatives such as the Quest for Intelligence and the formation of the new College of Computing.

The program offers important new opportunities for students and faculty. As first-class citizens of two departments and two schools, the students will become members in a community of students collectively engaging in this exciting emerging discipline. Faculty will have new opportunities to shape the education of highly qualified students and to create a new cadre of graduates who are uniquely qualified to address the cutting-edge research questions both today and the future.

We have discussed this proposal with faculty members in EECS who are experts in this area, with the department leadership, and at an open meeting of EECS faculty (November 26, 2018). The reception has been quite positive. The Department of Electrical Engineering and Computer Science is enthusiastic about this joint program and is happy to contribute to its development and deployment.

EECS will contribute to administering the program and to advising, with BCS faculty serving as the primary advisors to students in the program.

We look forward to working with our colleagues in BCS to develop this new curriculum at the interface between our disciplines.

Sincerely,

Asuman E. Ozdaglar

Asu Ozdaglar
Distinguished Professor of Engineering
Department Head, MIT Electrical Engineering and Computer Science

School of Engineering
ANANTHA P. CHANDRAKASAN
Dean of Engineering
Vannevar Bush Professor of Electrical Engineering and Computer Science

February 26, 2019

Dear Colleagues,

I am writing in strong support of the proposed undergraduate joint major to be offered by the Department of Electrical Engineering and Computer Science and the Department of Brain and Cognitive Sciences.

The new joint program leverages ongoing advances at MIT in understanding how neural circuits and networks process information that ultimately leads to intelligent behavior, and how this understanding can be replicated in machines and used to create improved interfaces with the brain.

The new joint major in 6-9 builds on an already strong relation between EECS and BCS as well as Institute-wide enthusiasm for initiatives such as the Quest for Intelligence and the formation of the new College of Computing.

We discussed this proposal at Engineering Council (January 27, 2019), and the reception was quite positive.

The School of Engineering endorses the plan to establish this joint program as a joint venture with the School of Science. EECS will contribute to administering the program and to advising, with BCS faculty serving as the primary advisors to students in the program.

Sincerely,

Anantha P. Chandrakasan
Dean, MIT School of Engineering
Vannevar Bush Professor of Electrical Engineering and Computer Science

77 Massachusetts Avenue, Building 1-206 Cambridge, MA 02139-4307
t 617.258.0818 **f** 617.253.8549 http://engineering.mit.edu

SCHOOL OF SCIENCE
Massachusetts Institute of Technology

Michael Sipser
Dean of Science
Donner Professor of Mathematics

February 22, 2019

To Whom It May Concern:

I write this letter in strong support of the proposed undergraduate joint major between the Department of Brain and Cognitive Sciences and the Department of Electrical Engineering and Computer Science (SB-6-9). This proposal was discussed at Science Council on February 8, 2019, where there was unanimous support for the proposal. This new degree will offer MIT undergraduates the opportunity to receive state-of-the-art training in emerging fields at the interface of computer science, artificial intelligence and brain and cognitive sciences. It also interacts synergistically with recent institute efforts, such as the Quest for Intelligence and the College of Computing.

The School of Science supports this plan to establish a joint degree program as an equal collaboration with the School of Engineering, with the BCS and EECS departments equally sharing the costs of teaching and development of new courses. In recognition of the existing high advising load of EECS faculty, BCS will take on primary advising responsibilities for students in the program.

Best regards,

Michael Sipser
Dean of Science

cc: M. Fee
H. Williams

617.253.8900 | sipser@mit.edu | science.mit.edu
77 Massachusetts Avenue, 6-131 | Cambridge, MA 02139-4307

Duane S. Boning, Chair
Committee on the Undergraduate Program (CUP)

Massachusetts Institute of Technology
77 Massachusetts Avenue, Building 5-133
Cambridge, Massachusetts 02139–4307

March 11, 2019

Professor Michale Fee
Professor Dennis Freeman
MIT

Dear Proposal Sponsors,

Thank you for updating the Committee on the Undergraduate Program (CUP) on your proposal for a joint 6-9 SB program during the 20 February 2019 CUP meeting. The Committee discussed your complete proposal, including letters of support and updated title (*Bachelor of Science in Computation and Cognition*) during its meeting on 6 March – based on that discussion the Committee supports this new SB program to be available for students starting in Fall 2019.

The Committee on the Undergraduate Program (CUP) is charged with oversight of undergraduate advising and therefore is particularly interested in hearing how your plan for dual advising meets the needs of students. As you learn from the experience in dual advising with the new major, it would be valuable to share that experience with CUP in the future.

The CUP would like to compliment you in the integration of feedback. We look forward to hearing about the success of this new SB. Please let me know how the Committee can be of further assistance and if you have any questions.

Sincerely,

Duane S Boning

Duane S. Boning
Clarence J. LeBel Professor of Electrical Engineering
and Chair of the CUP

cc: Course 6 (S. Amarasinghe, L. Bella, T. Heldt, P. Golland, L. Kaelbling, A. Ozdaglar)
Course 9 (J. Auerbach, S. Vallin, D. Zysman)
SoE (A. Chandrakasan)
SoS (M. Sipser)
CoC (D. Vogan, P. Walcott)
FPC (S. Silbey, T. Kaplan)
SOCR (C. Kaiser, R. Williams, K. MacArthur)

Course 6 – 9
Human and Machine Intelligence (13.5 subjects)

Other *: 4**

- **6 or 9 Advanced Project (CI-M)**
- **EECS/BCS** Joint Subjects
- **6 or 9 Laboratory (CI-M)**
- 1 of:
  - **EECS/BCS** Joint Subjects
  - **BCS** Elective Subjects

Header *: 3**

- **6.036** ML
- 1 of:
  - **6.034** AI
  - **6.003** Signals and Systems
- **Course 9 Cognitive/Computational Subject** Cognition/Linguistics/Neural Networks 9.66/9.19/9.53/9.ILA/9.85

Foun-dations: 3

- 2 of:
  - **6.006** Intro Algorithms
  - **6.009** Fundamentals of Programming
  - **6.002** Circuits and Electronics
- **Course 9 Foundational Subject in** Brain Systems/Neurophysiology 9.40/9.021/9.35/9.09

Intro: 1.5

- **6.0001** Intro Prog
- **9.01** Intro Neurosci

Math: 2

- 1 of:
  - **6.042** Math for CS
  - **18.03** Diff Eq
  - **18.06** Linear Algebra
- 1 of:
  - **6.041** Probabilistic Systems
  - **6.008** Inference
  - **9.07** Stats for Neuro

Roadmaps for Human and Machine Intelligence

Example 1

Year/Term	*Fall*	*Spring*
First	8.01 9.01# 18.01 CI-H	6.0001 8.02 18.02
Second	6.009 7.01 9.07	6.036 6.042 9.40
Third	5.111 6.034 9.66	6.006 9.19
Fourth	6.UAR 9.520	9.59

Example 2

Year/Term	*Fall*	*Spring*
First	8.01 9.01# 18.01 CI-H	6.0001 8.02 18.02
Second	6.009 7.01 6.041	6.036 6.042 9.40
Third	5.111 6.034 9.66	6.006 9.35
Fourth	9.PRJ 9.523	9.60

Example 3, Late entry (Third year)
Assuming Science GIRs + 6.0001 + 9.01 + 6.042 during first 2 years

Year/Term	*Fall*	*Spring*
Third	6.009 9.07 9.523	9.41 6.006 6.036 9.19
Fourth	6.034 9.66	9.40 9.60

Roadmaps for Neural Engineering

Example 1

Year/Term	*Fall*	*Spring*
First	8.01 9.01# 18.01 CI-H	6.0001 8.02 18.02
Second	6.009 7.01 9.07	6.002 9.40 18.03
Third	5.111 6.003	9.41 6.036
Fourth	9.17 9.21	6.027 9.53

Example 2

Year/Term	*Fall*	*Spring*
First	8.01 9.01# 18.01 CI-H	6.0001 8.02 18.02
Second	6.009 7.01 9.07	6.002 9.09 18.03
Third	5.111 6.003 9.21	6.036 6.141
Fourth	6.UAT 9.66	9.26

Example 3, Late entry (Third year)
Assuming Science GIRs + 6.0001 + 9.01 + 18.03 during first 2 years

Year/Term	*Fall*	*Spring*
Third	6.002 6.009 6.008	9.PRJ 6.003 9.40
Fourth	6.036 9.17 9.21	9.35 9.53

First year exploratory subject

Entering Course 6-9 Program as First-semester Sophomore

Taking 162 units in major (overlapping 48 units with GIRs) and 66 units of unrestricted electives.

First Year

Fall	Units	Spring	Units
8.01	12	6.0001(Required 2)	6
9.01(Required 1, REST)[i]	12	6.0002	6
18.01	12	8.02	12
HASS, CI-H	12	18.02	12
		HASS	12
	48		48

Second Year

Fall	Units	Spring	Units
6.009(EECS 3, Institute lab)	12	6.036(EECS 1)	12
7.012	12	6.042[J](Math, REST)	12
9.07(Statistics)	12	9.40(Brain systems)	12
HASS, CI-H	12	HASS	12
Unrestricted elective	6		
	54		48

Third Year

Fall	Units	Spring	Units
5.111	12	6.006(EECS 4)	12
6.034(EECS 2)	12	9.19(Joint elective)	12
9.66[J](Cognition)	12	HASS	12
HASS	12	Unrestricted elective	12
	48		48

Fourth Year

Fall	Units	Spring	Units
6.UAR(Project)	6	6.UAR(Project, CI-M)	6
9.46(Elective 2, HASS)	12	9.59[J](Program lab, CI-M)	12
HASS	12	Unrestricted elective	12
Unrestricted elective	12	Unrestricted elective	12
Unrestricted elective	12		
	54		42

Total Units: 390

Entering Course 6-9 Program as Second-semester Sophomore

Taking 162 units in major (overlapping 36 units with GIRs) and 54 units of unrestricted electives.

First Year

Fall	Units	Spring	Units
8.01	12	6.0001(Required 2)	6
9.01(Required 1, REST)'	12	6.0002	6
18.01	12	8.02	12
HASS, CI-H	12	18.02	12
		HASS	12
	48		48

Second Year

Fall	Units	Spring	Units
7.012	12	6.009(EECS 3, Institute Lab)	12
HASS, CI-H	12	6.036(EECS 1)	12
HASS	12	6.042[J](Math, REST)	12
Unrestricted elective	12	HASS	12
Unrestricted elective	6		
	54		48

Third Year

Fall	Units	Spring	Units
5.111	12	9.35(Elective 2)	12
6.006(EECS 4)	12	9.40(Joint elective)	12
6.034(EECS 2)	12	9.60(Program lab)	12
9.07(Statistics)	12	HASS	12
	48		48

Fourth Year

Fall	Units	Spring	Units
9.66[J](Cognitive)	12	9.18[J](Brain systems)	12
9.PR[J](Project, CI-M)	12	HASS	12
HASS	12	Unrestricted elective	12
Unrestricted elective	12	Unrestricted elective	12
	48		48

Total Units: 390

Entering Course 6-9 Program as First-semester Junior

Taking 159 units in major (overlapping 36 units with GIRs) and 57 units of unrestricted electives.

First Year

Fall	Units	Spring	Units
8.01	12	6.0001(Required 2)	6
9.01(Required 1, REST)[i]	12	6.0002	6
18.01	12	8.02	12
HASS, CI-H	12	18.02	12
		HASS	12
	48		48

Second Year

Fall	Units	Spring	Units
7.012	12	5.111	12
HASS, CI-H	12	HASS	12
HASS	12	Unrestricted elective	12
Unrestricted elective	9	Unrestricted elective	12
	45		48

Third Year

Fall	Units	Spring	Units
6.009(EECS 3, Institute lab)	12	6.006(EECS 4)	12
6.042[J](Math, REST)	12	6.036(EECS 1)	12
9.07(Statistics)	12	6.141[J](Elective 2)	12
HASS	12	6.UAT(Project, CI-M)	9
		9.40(Brain systems)	12
	48		57

Fourth Year

Fall	Units	Spring	Units
6.034(EECS 2)	12	9.53(Cognition)	12
9.66[J](Joint elective)	12	9.60(Program lab)	12
HASS	12	HASS	12
Unrestricted elective	12	Unrestricted elective	12
	48		48

Total Units: 390

[i] First year exploratory subject.