Biomedical Applications Concentration

Updated September 27, 2024

Symbolic Systems majors completing the new Core requirements effective for 2020-2021 must complete the following requirements to qualify for a Concentration in Biomedical Applications. All courses must be taken for 3 units of more. Notes: Core requirements fulfilled by a course are noted in brackets "[]". "*ASSR*" denotes courses that fulfill the Advanced Small Seminar Requirement.

Note: Courses that have been nominated and approved for requirements since the date that the list below was last updated (see note at the top for the date) are shown on the Course Nominations spreadsheet (requires a Stanford login). You can search or browse the spreadsheet to see all course nominations and whether they were approved or not.

1. ***Philosophical and Ethical inquiry***. For example, any of the following:
    - BIOE 131: Ethics in Bioengineering (ETHICSOC 131X)
    - BIOE 177: Inventing the Future (DESIGN 259)
    - FEMGEN 385N: Transfeminism (PHIL 385N)
    - HUMBIO 171E: Modern Ethical Challenges in Neuroscience and Organ Transplantation (MED 142)
    - HUMBIO 178A: Intro to Disability Studies: Disability and Technology
    - HUMBIO 174: Foundations of Bioethics
    - NBIO 101: Social and Ethical Issues in the Neurosciences (NBIO 201)
    - PHIL 85: Topics in Philosophy of Medicine
    - PHIL 134A: Phenomenology: Animals (PHIL 234A)
    - PHIL 167D: Philosophy of Neuroscience (PHIL 267D, SYMSYS 167D) [*Advanced Philosophy, Cross-Area Requirement*]
    - PHIL 168M: Biological Individuality (PHIL 268M) [*Introductory Philosophy*]
    - PHIL 178M: Introduction to Environmental Ethics (ETHICSOC 178M, ETHICSOC 278M, PHIL 278M, POLISCI 134L) [*Introductory Philosophy*]
    - PHIL 360: Grad Seminar: Philosophy of Neuroscience [*ASSR*]
    - PHIL 368A: Topics in Neuroscience [*ASSR*]
    - SYMSYS 202: Theories of Consciousness [*ASSR*]
    - SYMSYS 205: The Philosophy and Science of Perception [*ASSR*]

2. ***Theoretical and Mathematical Approaches***. For example, any of the following:
    - BIO 183: Theoretical Population Genetics (BIO 283)
    - BIO 223: Stochastic and Nonlinear Dynamics (APPPHYS 223, BIOE 213, PHYSICS 223)
    - BIO 251: Quantitative Evolutionary Dynamics and Genomics (APPPHYS 237)

- BIODS 215: Topics in Biomedical Data Science: Large-scale inference
- BIOMEDIN 219: Mathematical Models and Medical Decisions
- ECON 136: Market Design
- EE 102A: Signal Processing and Linear Systems I
- GEOPHYS 128: Modeling Earth (GEOPHYS 228)
- HUMBIO 88: Introduction to Statistics for the Health Sciences
- HUMBIO 89: Introduction to Health Sciences Statistics
- HUMBIO 154B: Principles of Epidemiology
- MATH 221B: Mathematical Methods of Imaging
- MS&E 292: Health Policy Modeling
- STATS 141: Biostatistics (BIO 141)
- STATS 215: Statistical Models in Biology

3. ***Computational and Design Methods***. For example, any of the following:
    - BIODS 220: Artificial Intelligence in Healthcare (BIOMEDIN 220, CS 271)
    - BIOE 273: Biodesign for Digital Health (MED 273)
    - BIOE 313: Neuromorphics: Brains in Silicon (EE 207)
    - BIOE 375: Biodesign Entrepreneurship for Societal Health
    - BIOMEDIN 210: Modeling Biomedical Systems: Ontology, Terminology, Problem Solving (CS 270)
    - BIOMEDIN 260: Computational Methods for Biomedical Image Analysis and Interpretation (CS 235, RAD 260)
    - BIOMEDIN 273B: Deep Learning in Genomics and Biomedicine (BIODS 237, CS 273B, GENE 236)
    - BIOMEDIN 279: Computational Biology: Structure and Organization of Biomolecules and Cells (BIOE 279, BIOPHYS 279, CME 279, CS 279)
    - CS 247B: Design for Behavior Change (SYMSYS 195B) [*Practicum, Integrative Requirement*]
    - CS 247S: Service Design (SYMSYS 195S) [*Practicum, Integrative Requirement*]
    - CS 273A: The Human Genome Source Code (BIOMEDIN 273A, DBIO 273A)
    - CS 279: Computational Biology: Structure and Organization of Biomolecules and Cells (BIOE 279, BIOMEDIN 279, BIOPHYS 279, CME 279)
    - CS 372: Artificial Intelligence for Disease Diagnosis and Information Recommendations
    - CS 379C: Computational Models of the Neocortex
    - CS 448B: Data Visualization (SYMSYS 195V) [*Cross-Area Requirement, Practicum, Integrative Requirement*]
    - GENE 211: Genomics
    - HUMBIO 51: Big Data for Biologists - Decoding Genomic Function
    - HUMBIO 151R: Biology, Health and Big Data
    - OTOHNS 206: Augmenting Human Senses: Enhancing Perception with Technology and Bioscience
    - PSYC 223B: Topics in Neurodiversity: Design Thinking Approaches

- PSYCH 204B: Computational Neuroimaging
- PSYCH 209: Neural Network Models of Cognition [ASSR]
- STATS 155: Statistical Methods in Computational Genetics
- STATS 220: Machine Learning Methods for Neural Data Analysis (CS 339N, NBIO 220, STATS 320)
- SYMSYS 245: Cognition in Interaction Design [*ASSR*]

4. ***Experimental and Observational Science***. For example, any of the following:
    - BIO 81: Introduction to Ecology
    - BIO 82: Genetics
    - BIO 83: Biochemistry & Molecular Biology
    - BIO 84: Physiology
    - BIO 85: Evolution
    - BIO 86: Cell Biology
    - BIO 150: Human Behavioral Biology (HUMBIO 160) [*Cognition Language & Neuroscience*]
    - BIO 151: Mechanisms of Neuron Death [*ASSR*]
    - BIO 204: Neuroplasticity: From Synapses to Behavior
    - BIODS 215: Topics in Biomedical Data Science: Large-scale inference
    - HUMBIO 2A: Genetics, Molecular Biology and Evolution
    - HUMBIO 2B: Culture, Evolution, and Society
    - HUMBIO 3A: Cell and Developmental Biology
    - HUMBIO 3B: Health Policy Analysis and Population Health
    - HUMBIO 4A: The Human Organism
    - HUMBIO 4B: Behavior, Health, and DevelopmentHUMBIO 51: Big Data for Biologists - Decoding Genomic Function
    - HUMBIO 151R: Biology, Health and Big Data
    - HUMBIO 154B: Principles of Epidemiology
    - MS&E 292: Health Policy Modeling
    - NBIO 206: The Nervous System
    - PSYC 124: Brain Plasticity
    - PSYCH 30: Introduction to Perception [*Cognition Language & Neuroscience*]
    - PSYCH 45: Introduction to Learning and Memory [*Cognition Language & Neuroscience*]
    - PSYCH 50: Introduction to Cognitive Neuroscience [*Cognition Language & Neuroscience*]
    - PSYCH 60: Introduction to Developmental Psychology [*Cognition Language & Neuroscience*]
    - PSYCH 80: Introduction to Personality and Affective Science
    - PSYCH 121: Ion Transport and Intracellular Messengers (PSYCH 228) [*ASSR*]
    - PSYCH 125: Research Methods in Psychology
    - PSYCH 146: Observation of Children
    - PSYCH 162: Brain Networks (same as PSYCH 267) [*ASSR*]

- PSYCH 168: Emotion Regulation (PSYCH 268) [*ASSR*]
- PSYCH 169: Advanced Seminar in Memory [*ASSR*]
- PSYCH 202: Cognitive Neuroscience
- PSYCH 204A: Human Neuroimaging Methods
- PSYCH 232: Brain and Decision Making [*ASSR*]
- PSYCH 254: Affective Neuroscience [*ASSR*]

5. ***Integrative Requirement***. Must be completed no earlier than the Junior Year:
    - Any of the *Standard Options* for all Concentrations specified under the Core Capstone requirement, or
    - A *Concentration-Specific Integrative Course* -- a course that integrates the themes of the Concentration with the Core requirements. One of the following [with more options to be added as they are approved -- some options may be removed if they are included in the list of SYMSYS 195* project courses, in order to avoid redundancy with the Standard Options]:
        - BIOMEDIN 210: Modeling Biomedical Systems: Ontology, Terminology, Problem Solving (CS 270)
        - BIOMEDIN 220: Artificial Intelligence in Healthcare (BIODS 220, CS 271)
        - BIOMEDIN 260: Computational Methods for Biomedical Image Analysis and Interpretation (CS 235, RAD 260)
        - BIOMEDIN 273A: The Human Genome Source Code (CS 273A, DBIO 273A)
        - BIOMEDIN 273B: Deep Learning in Genomics and Biomedicine (BIODS 237, CS 273B, GENE 236)
        - BIOMEDIN 279: Computational Biology: Structure and Organization of Biomolecules and Cells (BIOE 279, BIOPHYS 279, CME 279, CS 279)
        - COMM 326. Advanced Topics in Human Virtual Representation [*ASSR*]
        - COMM 372G: Seminar in Psychological Processing [ASSR]
        - CS 325B. Data for Sustainable Development (same as EARTHSYS 162, EARTHSYS 262) [*ASSR*]
        - CS 372: Artificial Intelligence for Disease Diagnosis and Information Recommendations
        - CS 379C: Computational Models of the Neocortex
        - HUMBIO 146: Culture and Madness: Anthropological and Psychiatric Approaches to Mental Illness (ANTHRO 186, ANTHRO 286, PSYC 286)
        - OTOHNS 206: Augmenting Human Senses: Enhancing Perception with Technology and Bioscience
        - PHIL 167D: Philosophy of Neuroscience (PHIL 267D, SYMSYS 167D) [*Advanced Philosophy, Cross-Area Requirement*]
        - PHIL 168M: Biological Individuality (PHIL 268M) [Introductory Philosophy]
        - PHIL 178M: Introduction to Environmental Ethics (ETHICSOC 178M, ETHICSOC 278M, PHIL 278M, POLISCI 134L) [Introductory Philosophy]
        - PHIL 360: Grad Seminar: Philosophy of Neuroscience [*ASSR*]

        - PHIL 368A: Topics in Neuroscience [*ASSR*]
        - PSYC 223B: Topics in Neurodiversity: Design Thinking Approaches
        - PSYCH 121: Ion Transport and Intracellular Messengers (PSYCH 228) [*ASSR*]
        - PSYCH 162: Brain Networks (same as PSYCH 267) [*ASSR*]
        - PSYCH 169: Advanced Seminar in Memory [*ASSR*]
        - PSYCH 202: Cognitive Neuroscience
        - PSYCH 204A: Human Neuroimaging Methods
        - PSYCH 204B: Computational Neuroimaging
        - PSYCH 232: Brain and Decision Making [*ASSR*]
        - PSYCH 254: Affective Neuroscience [*ASSR*]
        - PSYCH 273: Changing Mindsets and Contexts: How to Create Authentic, Lasting Improvement
        - STATS 220: Machine Learning Methods for Neural Data Analysis (CS 339N, NBIO 220, STATS 320)
        - SYMSYS 245: Cognition in Interaction Design [*ASSR*]

6. ***Contingent Electives***. If any of requirements 1-4 are fulfilled with courses taken for Core requirements, then additional approved Contingent Elective courses must be completed to total 5 courses beyond those that are taken for the Core. These electives can be one or more courses from any of the areas above, or which are approved for a Core requirement that the student has fulfilled with a different course, or any of the following:
    - ANTHRO 100X: "I'm Not a Robot": The Contemporary Politics of Man and Machine
    - ANTHRO 119W: Cyborg Anthropology
    - BIO 83: Biochemistry and Molecular Biology
    - BIO 103: Human and Planetary Health (BIO 203, MED 103, SOC 103, SUSTAIN 103)
    - BIOE 177: Inventing the Future (DESIGN 259)
    - COMM 153B: Free Speech, Democracy and the Internet (COMM 253B)
    - CS 139: Human-Centered AI
    - CS 152: Trust and Safety Engineering
    - CS 257: Introduction to Automated Reasoning [Cross-Area Requirement]
    - CS 329X: Human Centered NLP (CS 129X)
    - EDUC 482: Design to Equip Learners in Under-Resourced Communities (DESIGN 294)
    - EE 364A: Convex Optimization I (CME 364A)
    - EE 374: Blockchain Foundations
    - ENGR 50M: Introduction to Materials Science, Biomaterials Emphasis (MATSCI 50M)
    - ENGR 140A: Leadership of Technology Ventures
    - ENGR 145: Technology Entrepreneurship (ENGR 145S)

- ENGR 148: Principled Entrepreneurial Decisions (ENGR 248)
- ENGR 245: The Lean LaunchPad: Getting Your Lean Startup Off the Ground
- FEMGEN 106Q: Gender and Media
- FEMGEN 147: Feminism and Technology
- GLOBAL 124: Global Algorithmic Development and Ethics
- LAW 807S: Policy Practicum: Innovating Privacy Protection: Tools and Strategies for California Cities
- LINGUIST 1: Introduction to Linguistics
- MS&E 135: Networks
- MS&E 233: Game Theory, Data Science and AI
- OSPOXFRD 85: Practical Ethics for Artificial Intelligence
- OSPSANTG 25 "Health and Disease in an Aging Society: Chile in Transition"
- OSPSANTG 58: Global Change in Chile
- PSYC 60N: The Psychology of Stoked (LIFE 60N)
- PSYC 135: Dement's Sleep and Dreams (PSYC 235)
- PSYCH 12N: Self Theories
- PSYCH 24N: Neuroforecasting
- PSYCH 118F: Literature and the Brain (COMPLIT 138, COMPLIT 238, ENGLISH 118, ENGLISH 218, FRENCH 118, FRENCH 218, PSYC 126)
- PSYCH 144: The Sociocultural Shaping of Psychological Experience
- PSYCH 147: Development in Early Childhood
- PSYCH 146: Observation of Children
- PSYCH 220A: Probabilistic models of cognition: Reasoning and Learning (CS 428A) [Cross-Area Requirement]
- PSYCH 238: Wise Interventions (PSYCH 138, PUBLPOL 238)
- PSYCH 278: Psychology of the Climate Crisis [ASSR]
- PUBLPOL 103F: Ethics of Truth in a Post-Truth World (PUBLPOL 203F)
- PUBLPOL 134: Ethics on the Edge: Business, Non-Profit Organizations, Government, and Individuals (PUBLPOL 234)
- PUBLPOL 353B: Regulating Emerging Technology: Risks, Opportunities, and Reality
- SOC 45Q: Understanding Race and Ethnicity in American Society (CSRE 45Q)
- SOC 127: Solving Social Problems with Data (COMM 140X, DATASCI 154, EARTHSYS 153, ECON 163, MS&E 134, POLISCI 154, PUBLPOL 155)
- STATS 217: Introduction to Stochastic Processes I
- STS 10: Introduction to AI Safety (CS 120)
- STS 164: Ecosystems of Power: The Ethics and Influence of AI
- SYMSYS 104: Introduction to Race and Technology (ANTHRO 104D, CSRE 104)
- SYMSYS 168A: Black Mirror: A.I.Activism (AMSTUD 106B, ARTHIST 168A, CSRE 106A, ENGLISH 106A)
- The combination of SYMSYS 176S and OSPGEN 47 (both classes must be completed)
- Additional courses may be added here in the future