INFORMATION SESSION

Wednesday, April 5, 2023
WELCOME & INTRODUCTIONS

Director, Engineering Executive Education: Gary Henderson
AGENDA

• 6:00  Introductions
• 6:05  Master of Advanced Studies Overview
• 6:15  Wireless Embedded Systems (WES)
• 6:30  Architecture-based Enterprise Systems Engineering (AESE)
• 6:45  Data Science and Engineering (DSE)
• 7:00  Next Steps
• 7:05  Q&A
UC SAN DIEGO JACOBS SCHOOL OF ENGINEERING

- Jacobs School of Engineering (largest in CA among public universities)
- Ranked 10th top engineering school in the nation
- Distinguished faculty (>275 research-active faculty)
- Commitment to serving needs of industry for latest in research and education
- More rankings information can be found here: https://jacobsschool.ucsd.edu/about/rankings
Partnerships & Collaboration

Computer Science and Engineering

San Diego Supercomputer Center

Mechanical and Aerospace Engineering

Rady School of Management

Electrical and Computer Engineering

Qualcomm Institute

Images: David Baillot and Erik Jepsen
UC San Diego
MASTER OF ADVANCED STUDIES (MAS)

- Master’s degree, conferred by the UC San Diego
- Professional degree programs designed for engineering and technical professionals
- Unique interdisciplinary degree program focused on emerging technology areas and new fields traditional curricula do not address
- MAS degree programs
  - AESE - Architecture-Based Enterprise Systems Engineering (since 2010)
  - WES - Wireless Embedded Systems (since 2011)
  - DSE - Data Science and Engineering (since 2014)
  - More in development!
PROGRAM DESIGN

• Graduate degrees that meet the needs of engineering and technical professionals
• Designed to address skills that are most needed to solve today’s most pressing challenges
• Delivers integrated interdisciplinary knowledge
• Optimized for working professionals
• Cohort Design
• Small Class sizes
• Interactive and Application focused
GENERAL ADMISSIONS GUIDELINES

<table>
<thead>
<tr>
<th>Program</th>
<th>Work Experience</th>
<th>2023 Application Deadlines</th>
<th>General Guidelines For All Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AESE</td>
<td>5 years</td>
<td>February 8th</td>
<td>Bachelor’s degree in engineering, science, mathematics, physics, etc.</td>
</tr>
<tr>
<td>WES</td>
<td>2 years</td>
<td>April 5th</td>
<td>No GRE</td>
</tr>
<tr>
<td>DSE</td>
<td>2 years</td>
<td>June 7th</td>
<td>3.0 minimum GPA*</td>
</tr>
</tbody>
</table>

No TOEFL if working in US for more than 1 year*
$135 ($155 international) application fee**

*Some exceptions. **Veterans may request fee waiver.
## PROGRAM SCHEDULE

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>AESE</td>
<td>1 Year (full-time) 42 units total</td>
<td>13 units 13 units 13 units 3 units</td>
<td>3 classes 3 classes 3 classes capstone</td>
<td>3 classes + project 3 classes + project 3 classes + project</td>
<td>12 units 12 units 12 units 6 units</td>
<td>12 units 12 units 12 units 6 units</td>
<td>12 units 12 units 12 units 6 units</td>
</tr>
<tr>
<td>WES</td>
<td>2 Years (part-time) 36 units total</td>
<td>4 units 4 units 4 units 8 units</td>
<td>1 class 1 class 1 class 2 classes</td>
<td>1 class 1 class 1 class 2 classes</td>
<td>12 units 12 units 12 units 4 units</td>
<td>12 units 12 units 12 units 4 units</td>
<td>12 units 12 units 12 units 4 units</td>
</tr>
<tr>
<td>DSE</td>
<td>2 Years (part-time) 38 units total</td>
<td>6 units 8 units 8 units 8 units</td>
<td>1 class 2 classes 2 classes</td>
<td>1 class 2 classes 2 classes</td>
<td>12 units 6 units 2 units 2 units</td>
<td>12 units 6 units 2 units 2 units</td>
<td>12 units 6 units 2 units 2 units</td>
</tr>
</tbody>
</table>

AESE: 1 Year (full-time) 42 units total

WES: 2 Years (part-time) 36 units total

DSE: 2 Years (part-time) 38 units total

**UC San Diego Jacobs School of Engineering**
# FALL 2023 COHORTS PROGRAM COST

<table>
<thead>
<tr>
<th>Program</th>
<th>Units</th>
<th>Per Unit Tuition*</th>
<th>Tuition Includes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AESE</td>
<td>42 (1 yr)</td>
<td>$825/unit</td>
<td>Course Materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Software and Hardware</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Parking and Meals</td>
</tr>
<tr>
<td>WES</td>
<td>36 (2 yr)</td>
<td>$1,045/unit</td>
<td></td>
</tr>
<tr>
<td>DSE</td>
<td>38 (2 yr)</td>
<td>$990/unit</td>
<td></td>
</tr>
</tbody>
</table>

* Proposed per unit cost for student starting Fall 2023. Pending UCOP approval.

** Does not include UC Graduate Student Fees: https://students.ucsd.edu/finances/fees/registration/2022-23/self-supporting.html
SPECIFIC PROGRAM INFORMATION

Data Science & Engineering

Details available for each program

https://jacobsschool.ucsd.edu/mas
In the interest of time, questions will be answered in the Program Specific Q/A after the presentation.
WIRELESS EMBEDDED SYSTEMS

Faculty Directors: Dr. Ryan Kastner and Dr. Fred Harris
Learn the fundamentals of wireless communications and embedded system design and build advanced wireless embedded systems using modern design tools.

OVERVIEW

Faculty Directors
Dr. Ryan Kastner – Professor of Computer Science and Engineering
Dr. Fred Harris – Professor of Electrical and Computer Engineering

Intended Audience
Engineering professionals with a background in computer science and/or electrical engineering

Courses
2-year program (Sep 2023 – June 2025) with classes on alternating Saturdays or Fri/Sat 7 quarters, including summer 2024
Global Number of Connected IoT Devices

Number of global active IoT Connections (installed base) in Bn

- Wireless Neighborhood Area Networks (WNAN)
- 5G
- Other
- Cellular / M2M
- Wired
- LPWA
- Wireless Local Area Networks (WLAN)
- Wireless Personal Area Networks (WPAN)

Note: IoT Connections do not include any computers, laptops, fixed phones, cellphones or tablets. Counted are active nodes/devices or gateways that concentrate the end-sensors, not every sensor/actuator. Simple one-directional communications technology not considered (e.g., RFID, NFC). Wired includes Ethernet and Fieldbuses (e.g., connected industrial PLCs or I/O modules); Cellular Includes 2G, 3G, 4G; LPWAN includes unlicensed and licensed low-power networks; WPAN includes Bluetooth, Zigbee, Z-Wave or similar; WLAN includes Wi-Fi and related protocols; WNAN includes non-short range mesh; Other includes satellite and unclassified proprietary networks with any range.

Source: IoT Analytics Research 2018
Enable innovations across wide range of application domains

Wireless and low power

Complex system design tradeoffs: Performance, cost, form factor, and power consumption

Heterogenous: mix of SW and HW

Requires an interdisciplinary background in systems, software, hardware, and communication theory
<table>
<thead>
<tr>
<th>Fall Year One</th>
<th>Winter Year One</th>
<th>Spring Year One</th>
<th>Summer Year One</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Signal Processing</td>
<td>Intro to Embedded Systems</td>
<td>Digital Signal Processing II</td>
<td>Software for Embedded Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Year Two</td>
<td>Winter Year Two</td>
<td>Spring Year Two</td>
<td></td>
</tr>
<tr>
<td>Digital Communication Systems I</td>
<td>Digital Communication Systems II</td>
<td>Capstone Project</td>
<td></td>
</tr>
<tr>
<td>Hardware for Embedded Systems</td>
<td>Wireless Embedded Systems on a Chip</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ADMISSIONS GUIDELINES

• Bachelor’s Degree in engineering, science, physics, mathematics, etc.
• 3.0 minimum GPA
• Statement of Purpose
• 3 Letters of Recommendation
• Resume
• No GRE

Yvonne Wu
yvwu@ucsd.edu
ARCHITECTURE-BASED ENTERPRISE SYSTEMS ENGINEERING LEADERSHIP PROGRAM

Faculty Director: Dr. Jon Wade
Develop “systems thinking” capabilities which incorporates enterprise landscape, enterprise stakeholders, and enterprise goals/missions

OVERVIEW

Faculty Director
Dr. Jon Wade – Professor of Practice in Mechanical and Aerospace Engineering

Intended Audience
Engineers with five+ years of relevant professional experience who are in a position to drive enterprise systems

Courses
1-year program (Sep 2023 – August 2024)
Alternating Fridays/Saturdays + 1 four-day workshop per quarter
INDUSTRY 4.0

INDUSTRY 1.0: Mechanization, steam power, weaving loom
INDUSTRY 2.0: Mass production, assembly line, electrical energy
INDUSTRY 3.0: Automation, computers and electronics
INDUSTRY 4.0: Cyber-physical systems, internet of things (IoT), networks

Image Credit: International Business Times

Image Credit: INCOSE Vision 2025
THE TRANSITION

From: Systems Engineering 1.0

• Systems built to last
• Opinion-based decision making
• Paper-based documentation
• Deeply integrated architectures
• Hierarchical organizational model
• Satisfying the requirements
• Phase-based Verification & Validation
• Separated Development and Operations

To: Systems Engineering 2.0

• Systems built to evolve
• Model and Data-driven decision making
• Model-based documents
• Modularized architectures
• Ecosystem of partners
• Constant experimentation and innovation
• Continuous Verification & Validation
• Integrated Development and Operations
THE POWER OF DIGITALIZATION: EXTRACTING VALUE FROM DATA

Exploiting the digital power of computation, AI/ML, visualization and communication to take better, faster actions

- Simulated data
- Experimental data
- Observed data

Dynamic System Validation

Data Connection
- SQL, JCO, REST API, OMAPI
- HDFS, Swift, MySQL
- Online & Office

Data Composition
- Data Operations
- SED Data Sources
- Dynamic Queries
- View & Security Commands
- Analysis

Data Interactions across Data Sources

ORIENT
- Decision Automation
- Decision Modeling
- Decision Optimization
- Enterprise Analysis

OBSERVE
- Need & Execute Operations
- Market & Competitive Business Processes

PROCESS
- Process Flows: FMW, BPM
- Long-Range Transactions
- Secure, Distributed and Collaborative
- Robotic Process Automation (RPA)

ACT
- Act
- Deliver Demand

Image Credit: Flexrule™
Architecture-Based Enterprise Systems Engineering
Thinking & Leadership Program
“Information Age” Components
- Server farms
- The internet
- Digital capabilities
- Mobile devices
- Internet of Things (IoT)
- The Cloud
- Big data
- AI / machine learning...

We focus on the integration of previously unconnected systems and their interoperation to accomplish previously unavailable tasks.
AESE CURRICULUM

**USING**
- Systems Technology

**FALL**
- Systems Thinking
  - Leadership
  - Goals & Strategy
  - Finance / Accounting
  - Complex Systems
  - Agile Development
  - DevOps

**SPRING**
- Decision Systems
  - MOPs and MOEs
  - Event-driven Architectures
  - Art of Decision Making
  - Data Analytics
  - Big Data and Deep Learning
  - Investment Valuation and NOV
  - Managing Stakeholder Relationships

**WINTER**
- Systems Development
  - Enterprise Architectures
  - Architecture Frameworks
  - Use Cases/Capabilities
  - Domain Modeling
  - Service-Oriented Architecture
  - SOA Governance
  - Enterprise Cybersecurity
  - Functional & Physical Architectures

Team Project: Fall - Summer

- Concept Maps
- Planning Tools (eg., NOV)
- Use Case Template
- SysML and UAF
- Data Analytics Tools
- Cybersecurity Tools
- Concept Maps
- Planning Tools (eg., NOV)
- Use Case Template
- SysML and UAF
- Data Analytics Tools
- Cybersecurity Tools
Enterprise systems and system-of-systems are necessarily complex adaptive systems. Development of complex adaptive systems stresses heuristics through synthesis rather than analysis. Team projects are a major requirement for program completion.

70:20:10 Models

LEARNING MODEL

- Team Project Work
- In-Class Breakouts
- Courses

70%
On-the-Job Experience

20%
Mentoring & Coaching

10%
Classroom

DEVELOPMENT MODEL

- Architecture Development
- Defining Capabilities
- Defining Project

In-Class Breakouts

Courses
DEVELOPING SYSTEMS THINKING CAPABILITIES?

• Understand Enterprise Landscape
• Involve Enterprise Stakeholders
• Define a Goal and Mission, including a strategy and operational concept
• Identify Desired Capabilities
  • Consider Different Alternatives To Achieve The Capabilities
  • Create Business Process Models/Use Cases
• Develop Architectural Models
  • Verify Logic, Behavior, and Performance of Models
  • Emphasize Events and Decision-making
• Iterate The Earlier Considerations Based On Experimentation and Experience
• Become Leaders and Team Builders

This is what we do in AESE!
DELIVERY

• One-year program (September 2023 – August 2024)
  • Classes scheduled on alternating Fridays/Saturdays
  • One Wednesday – Saturday workshop per quarter
  • Class from 9:00a PT to 6:00p PT
  • Breakfast and lunch provided
• Classes offered sequentially
  • Three courses per quarter
  • One two-day Team Project meeting per quarter
• Each class has 32 contact hours (8 hours x 4 days)
• Final four-day Team Project / Capstone class at the end of August
ADMISSIONS GUIDELINES

• Bachelor’s Degree in engineering, science, physics, mathematics, etc.
• 3.0 minimum undergraduate GPA
• Statement of Purpose
• 2 Letters of Recommendation
• Typically, 5 years of relevant work experience or equivalent
• Informative Resume
• No GRE
DATA SCIENCE AND ENGINEERING

Faculty Directors: Dr. Ilkay Altintas and Dr. Alin Deutsch
OVERVIEW

Faculty Directors
Dr. Ilkay Altintas – Chief Data Science Officer, San Diego Supercomputer Center
Dr. Alin Deutsch – Professor of Computer Science and Engineering

Intended Audience
Engineering professionals with a background in computer science or other engineering or mathematics with substantial experience in data analysis.

Courses
2-year program (Sep 2023 – June 2025) with classes on alternating Fridays and Saturdays
WHAT IS BIG DATA?

106 Megabyte
1012 Terabyte
500TB of new data per day are ingested in Facebook databases

1015 Petabyte
The CERN Large Hadron Collider generates 1PB per second

1018 Exabyte
1EB of data is created on the internet each day

1021 Zettabyte

1024 Terabyte
500TB of new data per day are ingested in Facebook databases

1027 Brontobyte
The first Gigabyte hard drive was introduced by IBM in 1980 and weighed 550 lbs with a price of $40,000

1030 Geopbyte

1024 Yottabyte
THE EDUCATION OF A DATA SCIENTIST
# DSE COURSEWORK

<table>
<thead>
<tr>
<th>Fall Year One</th>
<th>Winter Year One</th>
<th>Spring Year One</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSE 200: Python for Data Analysis (4 units)</td>
<td>DSE 201: Data Management Systems (4 units)</td>
<td>DSE 220: Machine Learning (4 units)</td>
</tr>
<tr>
<td>DSE 290: Case studies in Data Science (2 units)</td>
<td>DSE 210: Probability and Statistics for Data Science (4 units)</td>
<td>DSE 230: Scalable Data Analysis (4 Units)</td>
</tr>
<tr>
<td><strong>CASE STUDIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Year Two</td>
<td>Winter Year Two</td>
<td>Spring Year Two</td>
</tr>
<tr>
<td>DSE 203: Data Integration &amp; ETL (4 units)</td>
<td>DSE 241: Data Visualization (4 units)</td>
<td>DSE 260B: Data Science Design Capstone Project (2 units)</td>
</tr>
<tr>
<td>DSE 250: Beyond Relational Data Models (4 units)</td>
<td>DSE 260A: Data Science Design Capstone Project (2 units)</td>
<td></td>
</tr>
</tbody>
</table>
ADMISSIONS GUIDELINES

• Bachelor’s Degree in engineering, science, physics, mathematics, etc.
• 3.0 minimum GPA
• Statement of Purpose
• 2 Letters of Recommendation (3 preferred)
• Resume
• No GRE

Yvonne Wu
yvwu@ucsd.edu
ADDITIONAL GUIDELINES

MAJOR Importance (at least 2/3)
1. Programming experience in a general-purpose language (C, Java, Python)
2. Experience with databases/SQL
3. Experience with data analysis in an application domain

MINOR Importance (strengthens your application)
1. Math: linear algebra, probability and statistics
2. Distributed Systems: Hadoop, Spark...
NEXT STEPS
NEXT STEPS FOR ALL PROGRAMS

For more information
JacobsSchool.ucsd.edu/MAS

Applications
Accepting Applications Now!
Applications are reviewed in the order received.
Next application review deadline: April 5th

More questions?
Contact Yvonne Wu or Stacey Williams

Yvonne Wu
Program Manager,
DSE and WES
ywwu@ucsd.edu

Stacey Williams
Program Manager,
AESE
sdw008@ucsd.edu
Q&A IN BREAKOUT ROOMS
THANK YOU!

JACOBSCHOOL.UCSD.EDU/MAS