Course Information

Course Code: 5710785
Course Section: 1
Course Title: ALGORITHMIC TRADING AND QUANTITATIVE STRATEGIES
Course Credit: 3
Course ECTS: 8.0

Course Catalog Description:
Coverage of market structure, trading instruments, processes and trading in general, including necessary background and terminology. Presentation and illustration of electronic trading infrastructure, software tools, networking protocols, data structures and order execution. Theoretical and practical analysis of financial time series data. Building the necessary statistical framework for algorithmic decision making. Detailed coverage of basic and advanced trading strategies including high-frequency techniques and related requirements. Illustration of portfolio management schemes. Informative discussion of global and local markets and associated risks, compliances and regulations.

Prerequisites:
No prerequisites

Consent of Dept./Inst.
This course provides a holistic coverage of financial market structure and dynamics, electronic trading infrastructure and software tools, and algorithmic trading strategies along with all necessary complementary terminology and information such as the compliances and regulations of both global and local markets. In this aspect, the course distinctively unites the domains of finance, econometrics and particularly computer science in order to provide the students with a strong multidisciplinary theoretical background that supports practical hands-on applications of modern trading technologies for today's sophisticated financial markets and trading instruments. Intense practical side of the course leans very heavily on artificial intelligence, machine learning, algorithms, data structures and software engineering fields. High speed computer networks and parallel computing fields will also be visited briefly. Therefore the course makes heavy use of and also requires a strong background in computer science. Moderate to high proficiency in calculus, differential equations, statistics, data structures, algorithms, machine learning and an advanced level of software development and software engineering skills will be necessary to follow the lecture material and to successfully complete intense programming assignments.

Corequisites:
MATH 120, MATH 219, STAT 221, CENG 213, CENG 350 or equivalent courses.

Schedule:
Tuesday, 14:40 - 17:30, -

Course Website: https://cow.ceng.metu.edu.tr/Courses/?course=ceng785&semester=20151

Instructor Information

Name/Title: Assist.Prof.Dr. SELİM TEMİZER
Office Address: Department of Computer Engineering, B-108
Email: temizer@metu.edu.tr
         temizer@ceng.metu.edu.tr
Personal Website: http://selimtemizer.com
Office Phone
Office Hours: By appointment

Course Objectives
Successful alumni of this course will have acquired a strong theoretical background and a large set of practical computational skills that are necessary for building up a competitive edge in utilizing modern trading strategies and technologies to capitalize on today's sophisticated financial markets and trading instruments.

Course Learning Outcomes
Student that pass the course satisfactorily will be able to:

- Define, describe, illustrate, explain, articulate and elaborate on the fundamental terminology, concepts, principles and functionality of financial instruments, financial markets and market participants.
- Design computer-based algorithms and systems for electronic trading of financial instruments using industry-standard communication protocols.
- Understand the principles of and operate in a sound and solid algorithmic decision making framework.
- Build, analyze, compare and differentiate between computational models of financial engineering and trading by identifying,
assessing and reasoning about their advantages and disadvantages.

### Program Outcomes Matrix

**Master's (with thesis)**

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Level of Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Competence in fundamental and advanced knowledge of hardware and software Proficiency in problem solving.</td>
<td>X</td>
</tr>
<tr>
<td>2 The ability to follow the contemporary technical development, and Initiative and aptitude for self-directed learning.</td>
<td>X</td>
</tr>
<tr>
<td>3 They are capable of designing, and conducting experiments at advanced level.</td>
<td>X</td>
</tr>
<tr>
<td>4 The ability to design and implement systems involving hardware, software, and the interaction between the two through challenging projects.</td>
<td>X</td>
</tr>
<tr>
<td>5 Analyze and compare relative merits of alternative software design, algorithmic approaches and computer system organization, with respect to a variety of criteria relevant to the task (e.g. efficiency, scalability, security).</td>
<td>X</td>
</tr>
<tr>
<td>6 Strong interpersonal skills needed for working effectively in small, diverse groups on medium to large scale technical projects.</td>
<td>X</td>
</tr>
<tr>
<td>7 Strong oral communication skills essential for effectively presenting technical material to an audience and strong written communication skills and the ability to write technical documents that include specification, design, and implementation of a major project.</td>
<td>X</td>
</tr>
</tbody>
</table>

**Doctoral**

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Level of Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Competence in fundamental and advanced knowledge of hardware and software Proficiency in problem solving.</td>
<td>X</td>
</tr>
<tr>
<td>2 The ability to follow the contemporary technical development, and Initiative and aptitude for self-directed learning.</td>
<td>X</td>
</tr>
<tr>
<td>3 They are capable of designing, and conducting experiments at advanced level.</td>
<td>X</td>
</tr>
<tr>
<td>4 The ability to design and implement systems involving hardware, software, and the interaction between the two through challenging projects.</td>
<td>X</td>
</tr>
<tr>
<td>5 Analyze and compare relative merits of alternative software design, algorithmic approaches and computer system organization, with respect to a variety of criteria relevant to the task (e.g. efficiency, scalability, security).</td>
<td>X</td>
</tr>
<tr>
<td>6 Strong interpersonal skills needed for working effectively in small, diverse groups on medium to large scale technical projects.</td>
<td>X</td>
</tr>
<tr>
<td>7 Strong oral communication skills essential for effectively presenting technical material to an audience and strong written communication skills and the ability to write technical documents that include specification, design, and implementation of a major project.</td>
<td>X</td>
</tr>
</tbody>
</table>
Non-Thesis Master's (Evening)

Program Outcomes

<table>
<thead>
<tr>
<th>Level of Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

1. Competence in fundamental and advanced knowledge of hardware and software Proficiency in problem solving.  
   - Level of Contribution: 3

2. The ability to follow the contemporary technical development, and Initiative and aptitude for self-directed learning.  
   - Level of Contribution: 3

3. They are capable of designing, and conducting experiments at advanced level.  
   - Level of Contribution: 3

4. The ability to design and implement systems involving hardware, software, and the interaction between the two through challenging projects.  
   - Level of Contribution: 3

5. Analyze and compare relative merits of alternative software design, algorithmic approaches and computer system organization, with respect to a variety of criteria relevant to the task (e.g. efficiency, scalability, security).  
   - Level of Contribution: 3

6. Strong interpersonal skills needed for working effectively in small, diverse groups on medium to large scale technical projects.  
   - Level of Contribution: 3

7. Strong oral communication skills essential for effectively presenting technical material to an audience and strong written communication skills and the ability to write technical documents that include specification, design, and implementation of a major project.  
   - Level of Contribution: 3

0: No Contribution 1: Little Contribution 2: Partial Contribution 3: Full Contribution

Instructional Methods

The following instructional methods will be used to achieve course objectives:

Lecture, questioning, demonstration and discussion.

Tentative Weekly Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Relevant Reading</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, Market Basics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Instruments and Processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Entities, Markets and Trading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Technology: Systems, Data and Networks</td>
<td>Homework 1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Electronic Trading: Structure, Platforms and Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Electronic Trading: FIX, Market Data, Order Book</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Financial Time Series: Statistics and Analysis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Week | Topic | Relevant Reading | Assignments
--- | --- | --- | ---
8 | Algorithmic Decision Making Framework |  | Homework 2
9 | Statistical Arbitrage |  | 
10 | Advanced Techniques |  | 
11 | High-Frequency Trading (HFT) and HFT Strategies |  | 
12 | Portfolio Management |  | Homework 3
13 | Local and Global Markets |  | 
14 | Risks, Compliances and Regulations |  | 

Course Textbook(s)
No Required Textbooks

Course Material(s) and Reading(s)

Material(s)
QuickFIX Engine

Reading(s)
Links posted on course COW page

Supplementary Readings / Resources / E-Resources

Readings
Reference Books:

Resources
Resources on web that will be posted on course COW website

Other
Various articles on quantitative trading on internet

Assessment of Student Learning

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Dates or deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and Participation</td>
<td>Every class hour</td>
</tr>
</tbody>
</table>
Assessment | Dates or deadlines
--- | ---
Homework 1 | After the 4th week of the semester
Homework 2 | After the 8th week of the semester
Homework 3 | After the 12th week of the semester
Midterm Test | After the 7th week of the semester
Final Test | After the last week of the semester

Course Grading

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and Participation</td>
<td>10</td>
</tr>
<tr>
<td>Homework 1</td>
<td>12</td>
</tr>
<tr>
<td>Homework 2</td>
<td>12</td>
</tr>
<tr>
<td>Homework 3</td>
<td>12</td>
</tr>
<tr>
<td>Midterm Test</td>
<td>26</td>
</tr>
<tr>
<td>Final Test</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Course Policies

*Class Attendance*

At least 80% attendance is required for satisfactory completion of the course.

*Class Participation*

Participation is encouraged and bonus points would be provided for constructive and regular participation.

*Late Submission of Assignments*

Late submission will not be accepted for homework assignments.

*Make up for Exams and Assignments*

Students need to provide official medical documentation (approved by Medical Department of METU) strictly within a week of missing an exam. Only in that case a make-up exam or a replacement grade might be provided.

For homework assignments and other projects no make-up opportunities will be provided (enough time is always granted until the due dates for each assignment/project).

*Final Exam Entrance Conditions*

In order to be allowed to the final test, students should satisfy ALL of the following requirements:
Attend at least 80% of the lectures
Submit all of the assignments
Score at least 40 (out of 100) on each of the assignment(s)
Score at least 40 (out of 100) on the midterm test(s)

Information for Students with Disabilities
To obtain disability related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the ODTÜ Disability Support Office as soon as possible. If you need any accommodation for this course because of your disabling condition, please contact me. For detailed information, please visit the website of Disability Support Office: http://engelsiz.metu.edu.tr/

Academic Honesty
The METU Honour Code is as follows: "Every member of METU community adopts the following honour code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."