CSE 492 Graduation Project Topics

The following are potential graduation project topics for this semester. In addition to these topics, you are welcome to propose your own project ideas. If you would like to discuss any of the topics below or your own idea, please email me at gterci@cse.yeditepe.edu.tr to arrange a meeting time that works for both of us. Thank you!

Gizem Sungu Terci

1. Performance Evaluation of Ordering Heuristics for the Weighted Vertex Coloring Problem

Project Description: In a graph coloring problem, we assign colors to the nodes of a graph so that no two connected nodes share the same color. Ordering heuristics such as First-Fit, Random, Largest-Degree-First, Incidence-Degree, Smallest-Degree-Last, and Saturation-Degree decide the order in which nodes get colored, which can greatly affect the result. This project focuses on the Weighted Vertex Coloring Problem, where each node also has a weight and the goal is to minimize the total cost based on those weights. Students will take well-known ordering heuristics, test them on weighted graphs, compare their performance, and then suggest or design a new heuristic to the weighted case.

2. Manipulating Dynamic Graphs Using Parallel Bitwise Engines

Project Description: Dynamic graphs are graphs whose nodes and edges can change over time. For example, new connections may appear or old ones may disappear. In this project, students will develop a new way to store and update dynamic graphs efficiently. Instead of using traditional data structures, the graphs will be represented using bit-vertex representations (as proposed in the paper), and parallel bitwise engines will be designed to apply updates. At each change in the dynamic graph (adding or removing nodes or edges), the updates will be performed using fast bitwise operations running in parallel. Students will then compare this new design against traditional dynamic graph construction and manipulation methods using performance metrics such as computation time, adaptation rate, and space usage.

3. A Genetic Algorithm for the Virtual Machine Placement Problem in Cloud Computing

Project Description: The Virtual Machine Placement (VMP) problem is a key challenge in cloud computing. It deals with assigning a large number of virtual machines

(VMs), each with specific resource needs (such as CPU and memory), to a limited set of physical machines (PMs) in a data center. The main goal is to use as few physical machines as possible while still satisfying all resource constraints. Efficient VM placement reduces energy consumption and operational costs and increases system performance. In this project, students will design and implement a genetic algorithm (GA) to solve VMP instances. They will use publicly available datasets (provided on GitHub) and evaluate the performance of their algorithm in terms of solution quality (how well the placement minimizes the number of physical machines) and computation time, comparing results across different parameter settings.

4. Solving the Register Allocation Problem by Using Local Search Strategies

Project Description: In modern compilers, register allocation is the process of assigning a large number of program variables (temporaries) to a limited number of CPU registers. Efficient register allocation improves runtime performance and reduces memory access. This problem can be modeled as a graph coloring problem, where each variable is represented by a vertex and an edge between two vertices indicates that the variables are simultaneously "live" and cannot share the same register. In this project, students will explore local search strategies such as hill climbing, simulated annealing, tabu search, and iterated local search to solve the register allocation problem. They will construct interference graphs from provided code samples, apply different local search methods to obtain near-optimal register assignments, and evaluate their performance in terms of register usage, spill cost, and execution time.

CSE492 Engineering Projects Proposals

Autumun 2025

Prof. Dr. Mert Özkaya
Department of Computer Engineering
Yeditepe University, Istanbul – Turkey
Founder, ArcMotus – www.arcmotus.com
Member, Presidential Council for Science, Technology, Industry, Innovation & Policy – Steering Committee on Digital Disaster Management
Tel: +90 216 578 04 20 Ext: 1424
Fax: +90 216 578 04 00
Group Page: http://serg.yeditepe.edu.tr
Personal Page: sites.google.com/site/drmertozkaya

Project 1: Model-Driven Smart Parking Management System

Aim: Develop a model-driven platform for intelligent parking management in collaboration with transportation industry partners. Students will:

- Design a custom modeling language representing parking systems from multiple perspectives (vehicle flow, parking space utilization, infrastructure layout, and dynamic behaviors).
- Build a modeling editor for interactive creation, visualization, and refinement of parking models.
- Implement model analysis tools for automatic validation, efficiency evaluation, and design optimization.

Collaboration Type: Industry collaboration (DFDS) with transportation/urban mobility companies

Supervisors/Advisors: Both academic and industrial supervisors

Project Type: Group project (2–4 students)

Project 2: AI-Assisted Smart Electric Vehicle Charging Management

Aim: Develop an intelligent EV charging management system in collaboration with industry partners. The system will:

- Provide personalized recommendations for optimal charging station selection based on driver preferences, battery levels, and real-time availability.

- Offer dynamic and proactive guidance during charging, including suggestions for productive use of parking time.
- Integrate AI-driven decision support to optimize both user experience and charging efficiency.

Collaboration Type: Industry collaboration with EV service providers and transportation companies (DFDS)

Supervisors/Advisors: Both academic and industrial supervisors

Project Type: Group project (2–4 students)

Project 3: Interactive Parking Layout Design Editor

Aim: Develop an interactive editor for parking layout design as an academic research tool. The editor will:

- Support multi-level garages, open lots, and street parking, enabling placement of vehicles, entrances/exits, and EV charging stations.
- Include optional image processing integration for working with real-world site photos.
- Serve as a research-grade tool for layout optimization, traffic flow analysis, and simulation studies.

Collaboration Type: Academic research collaboration with a faculty research group

Supervisors/Advisors: Academic supervisors

Project Type: Individual project

Project 4: Vision-Based Crop Row Detection for Autonomous Farming

Aim: Develop a vision-based system to detect and segment crop rows in agricultural fields, supporting autonomous navigation of farming machinery.

The system will:

- Implement both classical computer vision and deep learning approaches.
- Output row centerlines or navigation corridors to guide robotic vehicles.
- Provide benchmark comparisons of robustness under different field conditions (weeds, lighting, occlusions).
- Deliver a research-grade prototype suitable for autonomous driving and precision farming studies.

Collaboration Type: Industry collaboration (ArcMotus)

Supervisors/Advisors: Both academic and industrial supervisors

Project Type: Individual project

Project 5: Early Sepsis Prediction from ICU Time-Series Data

Aim: Design and evaluate a machine learning pipeline for early detection of sepsis in ICU patients using publicly available time-series datasets.

The system will:

- Ingest and preprocess ICU time-series data (vitals, labs) from open datasets (e.g., PhysioNet Sepsis Challenge or MIMIC-IV).
- Implement baseline machine learning models (e.g., logistic regression, XGBoost) alongside deep learning models (e.g., LSTM, GRU, Transformer).
- Predict sepsis onset several hours before clinical recognition, reporting AUROC, sensitivity, and lead time.
- Integrate interpretability methods (e.g., SHAP, attention weights) to highlight clinically relevant features.
- Serve as a research-grade tool for healthcare analytics and clinical decision support studies.

Collaboration Type: Industry collaboration (ArcMotus)

Supervisors/Advisors: Both academic and industrial supervisors

Project Type: Individual project

CSE492 Engineering Project Proposals
Fall 2025

Prof. Dr. Cem Ünsalan
Department of Computer Engineering
Yeditepe University, Istanbul – Turkey

End of Chapter (EOC) applications of the two books grouped as CSE492 Projects

Embedded Machine Learning with Microcontrollers
Applications on STM32 Development Boards
https://link.springer.com/book/10.1007/978-3-031-70912-8

Project 1 - Handwritten Digit Recognition from Digital Images

- Chapter 6, Classification, EOC 3
- Chapter 13, Convolutional Neural Networks, EOC 2
- Chapter 14, Recurrence in Neural Networks, EOC 2

Project 2 - Estimating Future Temperature Values

- Chapter 7, Regression, EOC 1
- Chapter 12, Embedding the Neural Network Model to the Microcontroller, EOC 4
- Chapter 14, Recurrence in Neural Networks, EOC 3

Project 3 – Clustering on Microcontrollers

Chapter 8, Clustering

- EOC 1: Fall Detection System
- EOC 2: Image Quantization by Clustering

Project 4 – Keyword Spotting from Audio Signals

- Chapter 13, Convolutional Neural Networks, EOC 1
- Chapter 14, Recurrence in Neural Networks, EOC 1

Embedded Machine Learning with Microcontrollers
Applications on Arduino Boards
https://link.springer.com/book/10.1007/978-3-031-69421-9

Project 5 - Handwritten Digit Recognition from Digital Images

- Chapter 6, Classification, EOC 3
- Chapter 13, Convolutional Neural Networks, EOC 2
- Chapter 14, Recurrence in Neural Networks, EOC 2

<u>Project 6 - Estimating Future Temperature Values</u>

- Chapter 7, Regression, EOC 1
- Chapter 12, Embedding the Neural Network Model to the Microcontroller, EOC 4
- Chapter 14, Recurrence in Neural Networks, EOC 3

<u>Project 7 – Clustering on Microcontrollers</u>

Chapter 8, Clustering

- EOC 1: Fall Detection System
- EOC 2: Image Quantization by Clustering

<u>Project 8 – Keyword Spotting from Audio Signals</u>

- Chapter 13, Convolutional Neural Networks, EOC 1
- Chapter 14, Recurrence in Neural Networks, EOC 1