TAC 380

Course Description

This course provides students with an in-depth introduction to technologies and techniques used in the game industry today. Students will learn to program and create several different games in C++, starting with 2D games and moving on to 3D. This course focuses on practical, hands-on information that's critical to learning how to be a successful video game programmer.

Learning Objectives

At semester's end, students will have:

1. Gained an understanding of core game systems (incl. rendering, input, sound, and collision/physics)
2. Developed a strong understanding of essential mathematics for games
3. Written several functional games in C++ individually
4. Learned critical thinking skills required to continue further study in the field

Prerequisite

CSCI 104L *or* TAC 365

Course Structure

Most class meetings will have one hour of lecture followed by one hour of in-class lab work. Students will be required to submit their code at the end of the lab period to demonstrate reasonable progress towards that week's lab assignment. There are a total of 12 lab assignments during the semester which are generally one week in length. Most weeks, an assignment is due on Wednesday at the end of day.

Exams

There are three ***in-person*** exams in the course:

- Midterm Exam (written) on 10/8 during your regular class period

- Programming Exam (timed in-class with computer) on 11/14 during your regular class period
- Final Exam (written) with the date/time depending on your section (schedule)

Textbook

Madhav, Sanjay. *Game Programming in C++*. Pearson. 2018. ISBN-10: 0134597206.

Students can read this book for free through the USC library website (here).

Alternatively, students can purchase a copy of the book from Amazon or the USC bookstore.

Schedule

W	First Hour	Second Hour
1	Course Intro; Game Programming Basics	
	Code Review; Style Guide	Lab 1 - Pong
2	Game Object Model; Intro to Vectors	Lab 1 - Pong
	More Vectors; Trigonometry	Lab 2 - Asteroids
3	Bounding Boxes	Lab 2 - Asteroids
	Leading Edges; Level; Dot Product	Lab 3 - Frogger
4	Platforming; Scrolling	Lab 3 - Frogger
	Animations; Sounds; Audio System	Lab 4 - Mario
5	Basics of AI for Games 1	Lab 4 - Mario
	Basics of AI for Games 2	Lab 5 - Pac-Man
6	Tile Mapping; Pathfinding Basics	Lab 5 - Pac-Man
	A* Pathfinding; Callbacks	Lab 6 - Zelda

W	First Hour	Second Hour
7	3D Graphics Basics	Lab - Exam Review
	Midterm Exam (Written; In person)	
8	Matrices; Basic Follow Camera	Lab 6 - Zelda
	Z-buffering; Lighting; Shading	Lab 7 - Star Fox
9	Spring Camera; Vehicle Physics	Lab 7 - Star Fox
	Height Map; Enemy Driving; Cross Product	Lab 8 - Mario Kart
	Spring Break	
	Spring Break	
10	FPS Cameras; Forces; 3D GetMinOverlap; Unprojection; Input Replay	Lab 8 - Mario Kart
	Quaternions; JSON Levels; SegmentCast	Lab 9 - Portal 1
11	Portal Views and Teleporting	Lab 9 - Portal 1
	Planes and Line Segments; Reflection Vector	Lab 10 - Portal 2
12	atan2; Z-buffering Revisited; Reflections and Ray Tracing	Lab - Exam Review
	Programming Exam (Timed with Computer; In person)	
13	Actor Parenting; Turret AI	Lab 10 - Portal 2
	Swept Shapes; Separating Axis Theorem	Lab 11 - Portal 3
14	3D Sound	Lab 11 - Portal 3
	User Interfaces	Lab 12 - Portal 4
15	Controllers; Porting	Lab 12 - Portal 4
	Getting into the Industry; Final Exam Review	

W	First Hour	Second Hour
	Final Exam (Written; In person)	

Weekly Breakdown

Where to Get Slides / Other Materials

All course materials not on the website including slides, practice problems, and practice exams, are available on the course Google Drive here (USC login required). This drive will be updated as the semester progresses, so you should keep it favorited. For convenience, a link is included in the top toolbar on this website.

Week 1

Tuesday

Lecture: Course Intro; Game Programming Basics

Suggested Readings

- Ch. 1 (pp. 1-14; 23-31)
- For the online version, this is the start of Chapter 1 through the end of "The Game Loop and Game Class"; and "Updating the Game."

Before Thursday's Class

Complete Lab Setup Instructions (Mac) (PC)

Thursday

Lecture: Code Reviews; Style Guide
Lab: Start Lab 1: Pong

Supplemental Content

- If you are unfamiliar with or need a refresher on C++, read the C++ Refresher
- For a refresher on the math prerequisites of the course, read the Math Refresher

Upcoming Dates

- The final version of Lab 1 is due Wednesday of Week 2

Week 2

Tuesday

Lecture: Game Objects; Vector Basics
Lab: Continue Lab 1: Pong

Suggested Readings

- Ch. 2 (pp. 33-42); Ch. 3 (skip dot/cross product)
- For the online version, this is "Game Objects" from Chapter 2 and everything in Chapter 3 other than the dot product and cross product sections.

Wednesday

Lab 1 is **DUE** at 11:59PM

Thursday

Lecture: More Vectors; Trigonometry
Lab: Start Lab 2: Asteroids

Supplemental Content

- For additional practice with this week's math concepts, try the Week 2 practice problems (problems and solutions on the Google Drive)

Upcoming Dates

- Grades for Lab 1 are out on Saturday
- Regrade requests for Lab 1 are due Tuesday of Week 3
- The final version of Lab 2 is due Wednesday of Week 3

Week 3

Tuesday

Lecture: Bounding Boxes
Lab: Continue Lab 2: Asteroids
Lab 1 regrade requests **DUE** at 11:59PM

Suggested Readings

- Ch. 10 (302-306; 311-312; 331-333)
- For the online version, read these sections from Chapter 10: “Axis-Aligned Bounding Boxes”, “AABB Versus AABB Test”, and the “Player Collision Against the Walls.”

Wednesday

Lab 2 is **DUE** at 11:59PM

Thursday

Lecture: Leading Edges; Level; Dot Product
Lab: Start Lab 3: Frogger

Suggested Readings

- Ch. 3 (pp. 68-70); Ch. 8 (pp. 248-251)
- For the online version, this is “Determining the Angle Between Two Vectors: Dot Product” from Chapter 3 and the start of Chapter 8 through the end of “Positive and Negative Edges”

Supplemental Content

- For additional practice with this week’s math concepts, try the Week 3 practice problems (problems and solutions on the Google Drive)

Upcoming Dates

- Grades for Lab 2 are out on Saturday
- Regrade requests for Lab 2 are due Tuesday of Week 4
- The final version of Lab 3 is due Wednesday of Week 4

Week 4

Tuesday

Lecture: Platforming; Scrolling
Lab: Continue Lab 3: Frogger
Lab 2 regrade requests **DUE** at 11:59PM

Suggested Readings

- Ch. 2 (pp. 50-53); Ch. 3 (pp. 79-81)
- For the online version, this is “Scrolling Backgrounds” from Chapter 2 and “Newtonian Physics” from Chapter 3

Wednesday

Lab 3 is **DUE** at 11:59PM

Thursday

Lecture: Animations; Sound Basics; Audio System
Lab: Start Lab 4: Mario

Suggested Readings

- Ch. 2 (pp. 44-50)
- For the online version, this is “Drawing Sprites” and “Animating Sprites” from Chapter 2

Upcoming Dates

- Grades for Lab 3 are out on Saturday
- Regrade requests for Lab 3 are due Tuesday of Week 5
- The final version of Lab 4 is due Wednesday of Week 5

Week 5

Tuesday

Lecture: Basics of AI for Games 1
Lab: Continue Lab 4: Mario
Lab 3 regrade requests **DUE** at 11:59PM

Wednesday

Lab 4 is **DUE** at 11:59PM

Thursday

Lecture: Basics of AI for Games 2
Lab: Start Lab 5: Pac-Man

Upcoming Dates

- Grades for Lab 4 are out on Saturday
- Regrade requests for Lab 4 are due Tuesday of Week 6
- The final version of Lab 5 is due Wednesday of Week 6

Week 6

Tuesday

Lecture: Tile Mapping, Pathfinding Basics
Lab: Continue Lab 5: Pac-Man
Lab 4 regrade requests **DUE** at 11:59PM

Wednesday

Lab 5 is **DUE** at 11:59PM

Thursday

Lecture: A* Pathfinding, Callbacks
Lab: Start Lab 6: Zelda

Suggested Readings

- Ch. 4 (pp. 104-115)
- For the online version, this is "Heuristics" through the end of "Following a Path" in Chapter 4

Supplemental Content

- To prepare for the midterm in Week 7, do the midterm practice questions (questions and solutions on Google Drive). We will go over these during "lab" on Tuesday of Week 7.

Upcoming Dates

- Grades for Lab 5 are out on Saturday
- Midterm is during Week 7!
- Due to the midterm in Week 7, regrade requests for Lab 5 are due Tuesday of ***Week 8***

- Due to the midterm in Week 7, the final version of Lab 6 is due Wednesday of ***Week 8***

Week 7

Tuesday

Lecture: 3D Graphics Basics
Lab: Midterm Exam Review

Suggested Readings

- Ch. 1 (pp. 14-20); Ch. 5 (pp. 148-154)
- For the online version, this is the "Basics 2D Graphics" section through the end of "Basic Drawing Setup" in Chapter 1 and the "Transformation Basics" section in Chapter 5

Thursday

Midterm Exam (written; in-person) during class period

Upcoming Dates

- Regrade requests for Lab 5 are due Tuesday of Week 8
- The final version of Lab 6 is due Wednesday of Week 8

Week 8

Tuesday

Lecture: Matrices; Basic Follow Camera
Lab: Continue Lab 6: Zelda
Lab 5 regrade requests **DUE** at 11:59PM

Suggested Readings

- Ch. 5 (pp. 148-161)
- For the online version, this is "Transformation Basics" through the end of "Adding World Transforms to Actor" in Chapter 5

Wednesday

Lab 6 is **DUE** at 11:59PM

Thursday

Lecture: Z-buffering; Lighting; Shading
Lab: Start Lab 7: Star Fox Tunnel

Suggested Readings

- Ch. 6 (pp. 200-203; 206-211)
- For the online version, this is the "Out with the Painter's Algorithm, in with Z-Buffering" and "Lighting" sections in Chapter 6

Upcoming Dates

- Grades for Lab 6 are out on Saturday
- Regrade requests for Lab 6 are due Tuesday of Week 9
- The final version of Lab 7 is due Wednesday of Week 9

Week 9

Tuesday

Lecture: Spring Camera; Vehicle Physics
Lab: Continue Lab 7: Star Fox Tunnel
Lab 6 regrade requests **DUE** at 11:59PM

Suggested Readings

- Ch. 9 (pp. 281-286)
- For the online version, this is the "Follow Camera" section of Chapter 9

Wednesday

Lab 7 is **DUE** at 11:59PM

Thursday

Lecture: Z-buffering; Lighting; Shading
Lab: Start Lab 8: Mario Kart

Suggested Readings

- Ch. 3 (pp. 70-72)
- For the online version, this is the “Calculating a Normal: Cross Product” section

Upcoming Dates

- Grades for Lab 7 are out on Saturday
- Regrade requests for Lab 7 are due Tuesday of Week 10 (***the week we are back from Spring Break***)
- The final version of Lab 8 is due Wednesday of Week 10 (***the week we are back from Spring Break***)

Spring Break

Enjoy!

Week 10

Tuesday

Lecture: FPS Cameras; Forces; 3D GetMinOverlap; Unprojection; Input Replay
Lab: Continue Lab 8: Mario Kart
Lab 7 regrade requests **DUE** at 11:59PM

Suggested Readings

- Ch. 9 (pp. 276-280 and pp. 292-294)
- For the online version, this is the “First -Person Camera” and “Unprojection” sections in Chapter 9

Wednesday

Lab 8 is **DUE** at 11:59PM

Thursday

Lecture: Quaternions; JSON Levels; SegmentCast
Lab: Start Lab 9: Portal, Part 1

Suggested Readings

- Ch. 6 (pp. 185-189)
- For the online version, this is the "Euler Angles" and "Quaternions" sections in Chapter 6

Upcoming Dates

- Grades for Lab 8 are out on Saturday
- Regrade requests for Lab 8 are due Tuesday of Week 11
- The final version of Lab 9 is due Wednesday of Week 11

Week 11

Tuesday

Lecture: Portal Views and Teleporting
Lab: Continue Lab 9: Portal, Part 1
Lab 8 regrade requests **DUE** at 11:59PM

Supplemental Content

- To prepare for the programming exam in Week 12, check out the programming exam practice document on the Google Drive. We will go over this during "lab" on Tuesday of Week 12.
- For additional practice with this week's (and last week's) math concepts, try the Week 11 practice problems (problems and solutions on the Google Drive)

Wednesday

Lab 9 is **DUE** at 11:59PM

Thursday

Lecture: Planes and Line Segments; Reflection Vector
Lab: Start Lab 10: Portal, Part 2

Suggested Readings

- Ch. 10 (pp. 298-302; 314-315)
- For the online version, this is the "Line Segments", "Planes", and "Line Segment Versus Plane Test" sections of Chapter 10

Upcoming Dates

- Grades for Lab 9 are out on Saturday
- Due to the midterm in Week 12, regrade requests for Lab 9 are due Tuesday of ***Week 13***
- Due to the midterm in Week 12, the final version of Lab 10 is due Wednesday of ***Week 13***

Week 12

Tuesday

Lecture: atan2; Z-buffering Revisited; Reflections and Ray Tracing
Lab: Midterm Exam Review

Thursday

Programming Exam (timed with computer; in-person) during class period

Upcoming Dates

- Regrade requests for Lab 9 are due Tuesday of Week 13
- The final version of Lab 10 is due Wednesday of Week 13

Week 13

Tuesday

Lecture: Actor Parenting; Turret AI
Lab: Continue Lab 10: Portal, Part 2
Lab 9 regrade requests **DUE** at 11:59PM

Wednesday

Lab 10 is **DUE** at 11:59PM

Thursday

Lecture: Swept Shapes; Separating Axis Theorem
Lab: Start Lab 11: Portal, Part 3

Suggested Readings

- Ch. 10 (pp. 321-323; 329-331)
- For the online version, this is the “Dynamic Objects” and “Testing Box Collisions in PhysWorld” sections in Chapter 10

Upcoming Dates

- Grades for Lab 10 are out on Saturday
- Regrade requests for Lab 10 are due Tuesday of Week 14
- The final version of Lab 11 is due Wednesday of Week 14

Week 14

Tuesday

Lecture: Sounds in 3D
Lab: Continue Lab 11: Portal, Part 3
Lab 10 regrade requests **DUE** at 11:59PM

Suggested Readings

- Chapter 7 covers a lot more aspects of sound in game, including how to use FMOD

Wednesday

Lab 11 is **DUE** at 11:59PM

Thursday

Lecture: User Interfaces
Lab: Start Lab 12: Portal, Part 4

Suggested Readings

- Chapter 10 covers user interfaces

Supplemental Content

- To prepare for the final exam, check out the final exam practice document on the Google Drive. We’ll have a final exam review the last meeting of Week 15.

Upcoming Dates

- Grades for Lab 11 are out on Saturday

- Regrade requests for Lab 11 are due Tuesday of Week 15
- The final version of Lab 12 is due Wednesday of Week 15

Week 15

Tuesday

Lecture: Controllers; Porting
Lab: Continue Lab 12: Portal, Part 4
Lab 11 regrade requests **DUE** at 11:59PM

Wednesday

Lab 12 is **DUE** at 11:59PM

Thursday

Lecture: Getting into the Game Industry; Final Exam Review

Upcoming Dates

- Grades for Lab 12 are out on Saturday
- Regrade requests for Lab 12 are due Tuesday of next week
- The final exam is scheduled based on your section