Mathematical Principles of Computer Graphics
Ma 598

1. Course Description

Topics include: two dimensional algorithms; transformations, scaling, translations, rotations, matrix notation, line clipping, b-spline curve fitting, and recursion. Geometric tools for three dimensional algorithms, and affine and projective geometry are included. Viewing and perspective transformations, wire frame models, algorithms for the triangle decomposition of polygons and hidden-line elimination are included. Object oriented programming using C++ is included.

2. Goals of the Course

The purpose of this course is to present a systematic approach to programming languages. The student is expected to become familiar with several different level languages. Selected topics from the theory of formal languages and syntactic analysis are also discussed.

3. Instructional Procedures

The following resources will be used:
Textbook
Computer facilities of the Reckzeh Math Resource Center
Procedures and methods will include:

a. Lectures covering the theory and areas of application
b. Guest Lecturers discussing their specialties
c. Assignment of programming projects
d. Independent projects

4. Course Content

A. Data Structure and Algorithms
   a. Introduction.
   What is computer graphics
   Model of interactive graphics systems
   The display file
   b. Data structure, Data bases, and List Handling
   Formal definition of data structures
   Representation of data structures in a computer
   Data models and data base organization
   c. Picture structure and Picture transformations
   Domain transformations
   Geometric transformations

The perspective representation of three-dimensional objects
The "4 by 4-matriax" for rotation, scaling, translation, and perspective

d. Interpolation and approximation of curves and surfaces
Classical methods: Lagrange and Hermite interpolation
Interpolation with B-spline
Bezier approximation of curves
General principles of surface construction

B. Languages and Their Interpreters

a. Interaction Handling
Interactive input devices
Device independence
Attention handling

b. The display processor
The display console
the display generator
the display controller
High-performance display systems

c. Display file and picture file organization
Data base and display file revisited
Display file without subpicture calls
Display with subpicture calls
Display file and picture file

d. Language concepts for interactive computer graphics
High-level graphic programming languages
High-level graphic programming languages: two cases in point
L^4-an intermediate language for device-independence and intra system communication

e. High-level language implementation of display programming systems
Tasks of a graphical programming package
Language structures
Interaction handling routines

5. Evaluation Measures

a.	Class participation	10%
b.	Homework	10%
c.	Successful run of specified number of programs	25%
d.	Midterm examination	25%
e.	Final examination	30%

6. Bibliography

A. Required Text:

a. Interactive Computer Graphics: data structures, algorithms, languages, by Wolfgang K. Giloi, published by prentice-hall, inc, 1988

B. Supporting Bibliography

a. Adams, Joel, Leesma, Sanford and Nyhoff, Larry, C++: An Introduction to Computing, 2nd Ed., Prentice Hall, 1998.

b. Bronson, Gary and Menconi, Stephen, A First Book in C: Fundamentals of C Programming, 2nd Ed., ITP/West Publishing,1993

c. Elson, Mark, Concepts of Programming Languages, Science Research Assoc., Inc., 1983.

d. Graham, Neill, Learning C, McGraw-Hill, Inc, 1992

e. Katzan, Harry, Computer Systems Organization & Programming, Science Research Assoc., 1986.

F. Leendert, Ammeraal, Programming Principles in Computer Graphics, John Wiley & Sons, 1986.

g. Overland, Brian, C++ in Plan English, MIS Press, 1996.