Final Exam
Modeling for Computer Graphics
CPSC589/CPSC689 Lecture 01
Time:120 minutes
Date: Friday, April 21, 2006
Total: 6 questions and 100 marks

Please print your Name and Student Identification Number at the top of every page including the question page before you start the exam. ***Show your work and justify your answer.*** *Be sure to indicate when a question is continued, both on the page for that question and on the continuation page. The exam is closed book. There are no calculators or other aids permitted.*

1. (15 marks) Answer briefly the followings:
   (a) The disadvantageous of using $f(r) = \frac{k}{r^2}$ as the energy function for implicit modeling,
   (b) The disadvantageous of simple adaptive subdivision(T-junctions),
   (c) The description of 2D-manifolds.

2. (15 marks) Consider a triangular mesh with e edges, v vertices and f faces. Based on these values, compute the number of faces ,vertices and edges after one level of Loop subdivision. Show your calculations. **The mesh can have boundaries**.

3. (15 marks) The half-edge data structure is used for a given mesh. Write a function that returns all faces adjacent(shared an edge) to a given face.

4. (20 marks) 2D points $F_1, F_2, \ldots F_8$ are given. Using Haar wavelets we can obtain the coarse approximation C_1, C_2, C_3, C_4 and details
   (a) Derive associated matrices A, B, P and Q(be careful about the the size of matrices, we have 8 fine and 4 coarse points).
   (b) As necessary conditions, we must have $AP = I, AQ = 0, BP = 0$ and $BQ = I$. Check the correctness of $AQ = 0$ with the resulting matrices from the first part of question.
   (c) Draw a figure that demonstrate the act of A, B, P and Q matrices on $F_1, F_2, \ldots F_8$, C_1, C_2, C_3, C_4 and D_1, D_2, D_3, D_4.

5. (20 marks)Let A, B and C be three solid primitives with the following t-lists
   $t_A = (0.5, 2.5, 3.0, 4.0)$,
   $t_B = (1.5, 2.0)$,
   $t_C = (0.3, 1.2, 3.2, 5.0)$.
   (a) Find the t-list of the combined solid $S = (A - B) \cup C$.
   (b) Is the point P with the hit time(ray parameter) 2.1 is inside of S?
   (c) What is the hit time of the visible point of S?
   (d) Is the eye inside of S?

6. (15 marks) Let $S(u)$ be an order k spline function over the knot sequence $\{u_0, u_1, \ldots, u_{m+k}\}$ which doesn't have any multiple knot. We know $S(u)$ must have $(k-2)$ continuity over knots. if $S(u)$ has more continuity than $(k-2)$, it will be a polynomial. Prove this claim. *Hint: Show all polynomial segments are the same.*