university of bremen | computer science
fortgeschrittenen-praktikum grafische datenverarbeitung |
advanced topics in graphics programming
summer 2005
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Administrative data:
The course is a programming lab in the form of independent study on an advanced level.
VAK 03-708.31. Module 301-2. 2 SWS, 4 ECTS.
Participation is by personal arrangement only.
Listed for the Diplom-Informatik (Hauptstudium) and M.Sc. in Digital Media programmes.
Students of the B.Sc. in Digital Media programme may be admitted if qualified.
Starts with a preparatory meeting on April 20, 2005, from noon to 1 p.m., in OAS 3000 (Linzer Straße 9a).
There will be no fixed class meetings afterwards. Instead, individual study plans will be arranged for each participant, or pair of such.

The

figures above show views of virtual reconstructions of two sites, the Merzbau and the Studiengalerie at the University of Stuttgart. The Merzbau was a fantastic sculpture by Kurt Schwitters, the Hannover based Dadaist artist. The major work he produced over a period of time in his parents' home was demolished during World War II. The Studiengalerie Stuttgart belonged to the institute of the philosopher, Max Bense. It became the venue of the first exhibition of computer art (Feb. 1965). Of both sites, there exist geometric models in VRML format that are avaiable to you.

Our proposal for your programming task is the following. We want you to produce a variety of renderings that are applied to either one of the models, preferrably, however, to the Studiengalerie. It should be possible for an observer to look at each one of them in turn by selecting the wanted one from a menu, to go from one to a next one, or even to position two such renderings into different windows. The transition from one rendering to a new one should appear as a gradual blending. Renditions should be photorealistic as well as sketch-like or other kinds of non-photorealism.

The common part of the proposal is to create an interface that will be shared by all contributors. Each contributor would deliver several renderings (two or three). They should, in particular, be selected from, but not be restricted to, the list:

- pencil drawing
- water color
- oils
- other drawing tools
- cartoon style
- cubist style

Steps in your project work would include:

- jointly discuss, design, and agree on a common interface (functionality and visual appearance)
- study some relevant literature on (non-photorealistic) rendering (see below)
- select two or three styles for each participant
- write agreements for the specific tasks
- start working
- have a joint final demonstration

What

are you expected to do for the advanced lab in graphics programming?

We want to reach such students of the Hauptdiplom Informatik and the M.Sc. in Digital Media programmes, who are looking for a real challenge. If you consider taking this lab, you should be advanced in the area of computer graphics. That is, you should at least have taken an introductory class on interactive computer graphics, or you should in some other way have gained experience in interactive computer graphics, in its theory and programming. You should be familiar with a good textbook in the field, but your experience should not be restricted to reading books; you should, at any rate, have done some graphics programming. You should have a working knowledge of C or C++ to the degree that you independently find your way as you develop an algorithmic solution to a non-trivial problem.

It goes without saying that you must be capable of independently working on your own. Quite frankly, you should love to do that. Why else would you take an independent study class?

We stress this point because the approach of the lab is directed to only those few, who are ready to do serious independent work. After a first introductory meeting, our schedule does not include any further class meetings. We will not teach you by taking you by the hand. We will instead try helping you to do your own work. We will arrange for a contract with you, under which you will be asked to finish your personal non-trivial assignment within a period of *precisely eight weeks*. You determine the day when that individual period of eight weeks starts. You may work in *groups of two*, if you want.

As far as computer graphics is concerned, you must know the fundamentals: raster graphics, ray tracing, radiosity, shading, modeling objects and scenes in 3D space with splines and other techniques, and graphic interfaces. And, of course, the mathematics of all that should not cause a nervous breakdown for you. You must be proficient in such matters to such a degree that you may independently work on a problem that requires understanding important algorithms, concepts, and methods of those areas. You should be interested in a graphics specialization of your studies, and feel comfortable with doing individual project work. You may, of

course, ask for advice during the eight weeks period. If your general programming skills are restricted to a lower level, you should think twice before taking this class.

We start by explaining the format and introducing our proposals for your choice of individual task. You are expected to select one of them (see the list below). After we have precisely formulated your project in concord with you, we agree with you on two individual checkpoints and the date of your final presentation.

The lab's general features are:

- You gain insight into some recent scientific literature on graphics.
- You gain experience in doing thorough and well-planned programming.
- You get an opportunity to solve a problem all by yourself.
- You work on a problem originating in the current research of our group, *agis*, and you solve it to the point of demonstration.
- You start at almost any point in time.
- You may take the lab as preparation for your thesis work.

The schedule roughly calls for the following. You pick one of the problems we suggest, and you do so individually or in pairs. We take up specifics you may raise concerning the problem definition, and we formulate your personal problem specification after the first warm-up meeting. You work on your problem for no more than eight weeks. At two intermittent checkpoint meetings, you present preliminary results. We are ready to give you advice at almost any time (though not by night), via email, phone, or meeting over a cup of coffee. The lab ends with your demonstration of the software, and a written report.

The report must contain the problem specification, your approach for a solution, important algorithmic steps, data structures, and geometric modeling decisions. You should also draw a conclusion for further work, and comment on your learning experience. The report should contain pictures and diagrams where ever appropriate. It must be written in a clear and precise style, refer to the most important literature, and convince us of your expertise. The paper should have a length of between 8 and 12 pages.

As already mentioned, it is possible to start at any time during the semester, but such that you are finished before its definite end (September 30, 2005). We agree on details of your specific time slot in advance, and to your advantage. Our promise is to maximally support your independent study. You must, however, be aware of the fact that Frieder will be away for certain periods in the summer of 2005, and Andreas' current job with the university will end in July.

The problem specification defines minimal requirements, which your solution must satisfy. We say a word about the hardware and software you are allowed, or expected, to use, and we hint at some literature you may be requested to study. OpenGL (and thus C or C++), Pixar RenderMan, Maxon Cinema 4D on an Apple Macintosh are typical candidates for software support.

By the end of your assignment, you should feel like having attained some extraordinary result after a demanding effort. You should be proud of what you have achieved, and we would want to share your pride. (Perhaps, your demonstration is worth to be presented to people from the outside.)

At the preparatory meeting, we present the assignments we invite you to. We fully specify your problem only after that first encounter so that we may take into consideration your preferences and conditions.

A general reference to the graphics literature besides the well-known standard of J. Foley, A. van Dam, St. Feiner, and J. Hughes: *Computer Graphics. Principles and Practice*. Reading, MA: Addison Wesley, is Alan Watt and Fabio Policarpo: *The Computer Image*. Reading, MA: Addison Wesley 1998.