

Distance Learning with Limited Bandwidth

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Abstract

This paper discusses an asynchronous distance-learning course offered by faculty at Manhattan College in New York to Bethlehem University, an Arab university in the West Bank. The course is Computer Architecture, a junior-level course in Bethlehem's Computer and Information Systems program. The motivation for offering the course through distance is that it is extremely difficult to get qualified faculty to physically go to the Arab West Bank.

The paper will discuss how we overcame the technical limitations of extremely limited bandwidth. It will also present the author's experiences in working with the Arab students in this mode of learning.

Introduction

Bethlehem University (BU) is a Catholic institution of higher learning in the town of Bethlehem in the Arab West Bank. Its student body consists of about 2600 Christian and Muslim Arabs and it offers 4-year degree programs in the faculties of Arts, Science, Business Administration, Education, Nursing and Hotel Management. Since it was founded in 1973, it has been run by English-speaking members of the De La Salle Christian Brothers.

In Fall 2003 Bethlehem University began its first computer major in Computer and Information Systems (CAIS) as part of the Faculty of Science. One of the challenges this new program faced, was recruiting qualified faculty as the program grew. A major obstacle is restricted travel in and out of Bethlehem.

When the major began, the author was a full-time member of the CAIS faculty, but has since returned to Manhattan College in New York. As the program entered its third year, there was a need for a new course in computer architecture. Since the author had expertise in this area, The program coordinator invited the author to offer the course through distance learning. A local faculty member was assigned to act as onsite course coordinator.

Course Content

The course uses the text "Computer Organization and Design" by Patterson and Hennessy, third edition published by Morgan Kaufman. The major topics are Turing machines, data representation, computer arithmetic, instruction set architecture, procedure calls in MIPs, compiler optimization, MIPs single-cycle machine, pipelining, memory systems, peripheral interfacing and RAID. We rely on the MipsIt simulator for programming assignments.

Challenges

Some of challenges we faced were limited Internet bandwidth, student acceptance of a new mode of learning, language differences, and limited financial and laboratory resources. The biggest technical challenge was the limited bandwidth.

Currently Bethlehem University has a single 1 Mbit/sec Internet connection for the entire campus at a cost of \$1200 per month. During the hours students are on campus, all downloads of audio or video content must be blocked. This restriction made any sort of synchronous interaction with students impractical

except for text messaging or chat. It was impractical to upload any files from New York that were larger than a few megabytes

At the beginning, this was the first time that any students at BU had been exposed to asynchronous distance learning. The first onsite coordinator faced the challenge of getting the students to accept this new mode of learning.

The official language of instruction in the Faculty of Science is English. The majority of the students are fluent in English, but a significant number have difficulties with it. Even students who understand English, have difficulty with idiomatic English. In practice, many instructors use a mixture of English and Arabic in their lectures. Regrettably the author has little facility with Arabic so some students must rely on other students and teachers for explanations.

Methodology of Instruction

All lectures are prerecorded using the software Camtasia Studio by TechSmith to produce Windows Media videos. All of the recordings are screen casts capturing only audio and the PC's video display. No video image of the speaker is used in order to conserve bandwidth. Most of the videos are PowerPoint presentations recorded on a tablet PC. Cursor movements and pen strokes are captured to direct student attention during the lecture. The size of the video files was about 1 MB per minute.

Each week the author prepares about three hours of videos. He organizes these files, the PowerPoint slides and other supporting documents into a single folder with a simple html file serving as the "table of contents". These are placed in a single compressed file on the author's personal website. A technician from Bethlehem University must then download the file in the off hours and install it on a local server. As stated before, it is impractical to upload such a large file from New York.

Bethlehem University uses Moodle for its e-learning software. It is practical for the author to use this for posting grades, assignments and other small documents. It can also be used to collect most assignments. Students also use email as the means of submitting assignments and questions to the instructor.

A BU faculty member is assigned a one-credit load to act as onsite coordinator. He meets with the class once a week. At this meeting, students can discuss any issues related to the course. The instructor in New York keeps in close contact with the onsite person to make announcements, offer encouragement and monitor student progress.

Since the class size is over 35 students, it is impractical to give tests electronically. So the local coordinator proctors conventional paper exams. The answer sheets are scanned and emailed to New York for grading.

Each semester the instructor in New York flies to Bethlehem to give several lectures in person. The aim is to allow the students to make personal contact with the instructor and vice versa. This helps students to realize that the professor at a distance has the same expectations of them as local professors. The author finds this well worth the time and expense.

Outcomes

The course first ran in spring 2006 with 36 students. At first the students were hesitant to treat the course as one of their regular courses. It was necessary for the onsite coordinator to assemble the class for a group screening of the videos. Eventually students got used to the idea, and began to view the videos privately in the lab or at home. All the students passed with the majority of the grades being B or B+.

The first course was successful enough that we decided to try it again this semester with 37 students. Student acceptance was no problem this time because the positive experience of the previous group gave the new group confidence. As of this writing the current students were given one test where the class average was 96.5%. All the students have handed in the first five assignments on time. Unfortunately many of the assignments are copied, but this a common occurrence at BU.

After visiting the students in person, the author is convinced that the majority of the students are highly motivated and intelligent. Many expressed appreciation for the opportunity to take advantage of the author's expertise. There were a significant number who were having some difficulties with the course. For some it was language, but for most it was the work load.

Course Survey

In order to get some quantitative assessment of the course, the author administered a brief survey. Of 37 students in the class, 31 responded. The survey is reproduced below with quantitative results for itemized questions.

- 1 How many of the course videos can you view during the week?
13 All of them 7 About half of them ___ None of them
11 Some of them ___ A few of them
- 2 Where do you listen to the videos? (Check all that apply)
8 In a University lab 28 At home 2 On a friend's computer
___ Another place (please specify) _____
- 3 How well are you able to understand the material in the videos? (Check one)
1 I understand all the material very well.
16 I understand most of the material
9 I understand enough of the material adequately.
5 I understand about half the material.
___ I understand only some of the material
___ I understand very little of the material.
- 4 What can be done to improve the quality of the videos
- 5 When you have a question about course material, how do you get it answered besides asking a friend.
18 I send Br Henry an email
6 I ask the on-site coordinator
1 I ask another teacher
6 I do not like to ask teachers questions
- 6 Are you satisfied with the way this course is offered online?
8 Very satisfied 3 Its just ok. 1 I don't like it at all
14 Satisfied 5 There are problems
- 7 What do you like most about the course?
- 8 What do you like least about the course?

In question 4 about video quality, 12 students mentioned they were too long and 8 students wanted more worked out examples. As the author got used to making videos, he tended to have longer lectures. Some ran to about an hour and fifteen minutes. Since this survey, videos will be limited to 50 minutes. One student indicated he could not fast forward or reverse the video. This is the case when streaming the video, but it should be possible to do with Windows Media Player.

For question 7, six students liked the novelty of distance learning; Seven students liked the ability to replay videos for review. Five students mentioned the flexibility of time and place for viewing lectures. Five students liked the subject matter. Four students mentioned teaching style. Three mentioned the simulation software and two liked the fact that they had to be self reliant.

For question 8, seven students mentioned the length of the videos. Two mentioned the absence of a teacher. Three mentioned the delay in having questions answered by email. Three thought the subject matter was too complex. Two had a problem with the language. Three thought there were too many assignments. Two mentioned that others were copying assignments.

Conclusion

In the opinion of this author, this attempt to offer a distance learning course to undergraduates was a success. The motivation of the students is the most important reason for this. This project has demonstrated that it is quite feasible to give undergraduate students the benefit of expert teaching skills that are otherwise unavailable to them. It is indeed the author feels privileged to have had this opportunity.

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