

CS 435/535 Network and Distributed Programming

Viewed in the context of the OSI model, and consistent with its role in the three-quarter course sequence, CS 433-4-5, CS 435 is situated at the top OSI layers. Though bottom-up elements occur in discussion of OSI concepts and Unix-based application architectures, e.g. ftp and e-mail, most emphasis falls on a top-down user application focus within an extant distributed computing environment, as reflected in supporting materials: Rosenberry et al. [1], Shirley et al. [2], and Bloomer [3]. The course begins with a survey of the complex interacting software making up a mature distributed programming environment, OSF's DCE: Cell Directory Service (a naming service), time service mechanics and security, all covered at length using Rosenberry et al., along with mention of ONC analogs from Bloomer, demonstrations and hands-on experiences. Distributed file systems are cited as premier applications of client-server and remote procedure calling within both models.

The laboratory environment builds around a core (Sun) Solaris system, with student exercises mainly rooted in illustrations in Bloomer. Some material in Shirley et al., similar to Bloomer's, but for a DCE context, contains examples that, under small adaptation, can be run under Solaris or Linux, e.g., a vector addition example. OSF and ONC flavors thus dominate, but appropriate side commentary is provided on OSI [4] [5] and the Windows-NT variant, based on Rosenberry and Teague [6]. Both the IDL and ONC rpcgen-based protocol definition languages and compilers are discussed as the starting point in the top-down scheme. Class assignments use the ONC system and a major assignment is a student-elected project; though a few are quite ambitious, e.g., running Rosenberry et al.'s example on a Linux port of DCE, most are positioned on safe ground near examples demonstrated in the classroom. Among the latter are a remote database query and update program, a remote (file and directory) listing command, and distributed image processing, based on Bloomer. RPC and windowing client-server approaches are contrasted via Bloomer passages, but distributed applications requiring GUIs rest on Tcl/Tk ware, e.g., kibitz and Tcl-DP. The first of these, via a character-based (curses) neural network package demonstration `{it cum}` talk-like utility, provides a groupware twist, which can be demonstrated on even the dated classroom display equipment. The second of these, a locally generated whiteboard proffering several sophisticated features involving screen area snapshots, extensive use of color and variable-size writing and drawing tools, requires an equipment base not available in current or, even, projected classrooms; it is thus restricted to the laboratory setting.

Additional lecture material briefly addresses coverage in other texts, e.g. Comer and Stevens [7], with a lighter touch provided by Malamud [8]. A brief excursion into modeling and simulation, e.g. concurrency and queuing mechanisms, suggests potential applications to system performance evaluation on both hardware and software fronts. Since CS 433 is a pre-requisite and CS 434 is either a pre- or co-requisite, these allusions are well based and integration across courses is thus facilitated. The material covered in CS 435 is heavily influenced by programming and operating systems considerations, so that the subject matter coordinates nicely with yet other sequences within the undergraduate curriculum. The course coverage, originally designed for a two-quarter sequence, is sometimes considerably telescoped, e.g., the Tcl-DP implementation details are left to student initiative. A more extended period for student projects would be helpful.

References

- [1] *Research Priorities in Networking and Communications* Report to the NSF Division of Networking and Communications Research and Infrastructure, 1992.

- [2] *Guide to Writing DCE Applications* by J. Shirley, W. Hu, and D. Magid, O'Reilly Associates, 1994.
- [3] *Power Programming Using RPC* by J. Bloomer, O'Reilly & Associates, 1992.
- [4] *Col 90* , by Col, 1990.
- [5] *Bla 91* by Bla, 1991.
- [6] *RT 93* by Rosenberry and Teague, 1993.
- [7] *CS 93* by Comer and Stevens, 1993.
- [8] *Mal 92* by Malamud, 1992.

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