The BOSS Online Submission System

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Summary

- What is BOSS?
  - history
  - current architecture
- Using BOSS
  - examples of dialogue
- Issues arising
- Dissemination and future work

Motivation

- Large class sizes
  - up to 300 students
- Programming modules
  - multiple assignments
  - formative
  - require rapid feedback
  - need to run program to mark it

What is BOSS?

- Course management utility
- Online submission
- Online marking
- For programming assignments
  - automatic testing
  - plagiarism detection

Pedagogical Issues

- Must not distract students
  - *not* a CAL tool!
- Must be accurate
  - ensure awarded marks can be reproduced
- Must not infringe academic freedom
  - i.e. must not prescribe marking schemes

Original Architecture (1993-)

- Collection of programs (UNIX - SunOS)
  - compiled C (some setuid)
  - Perl scripts
  - Tcl/Tk GUI
  - mSQL database
- Difficult to maintain or enhance
- Not easily portable

The World has Changed!

- New requirements
  - security
  - networking
- New environment
  - familiarity
  - programming tools
- 1999: decided to re-design and re-code

Problems (1998)

- Reliance on University network
- Bugs in NFS!
- Inextensibility of Tcl/Tk programs
- Data entry for test data
- Testing programs for correctness
  - hard!
  - OK with Pascal
  - Java a bit different

Limitations in I/O

- Lack of support for GUI in student programs
  - e.g. Java programs
- I/O handling under UNIX is messy
  - control characters
  - signal handling
- Actual vs. expected output
  - use of `diff`
  - misspellings, whitespace, ...

Limitations in OS

- Different platforms
  - PC, UNIX, Mac
- Networking not built in
- Multiple installation problems
- Security
  - security is that of host machine

New System Requirements

- Platform-independent
  - Java
- Accessible across the Internet
  - client-server model
  - Java *application* (not Applet)
- Reliable data
- Security
- Standards conformant

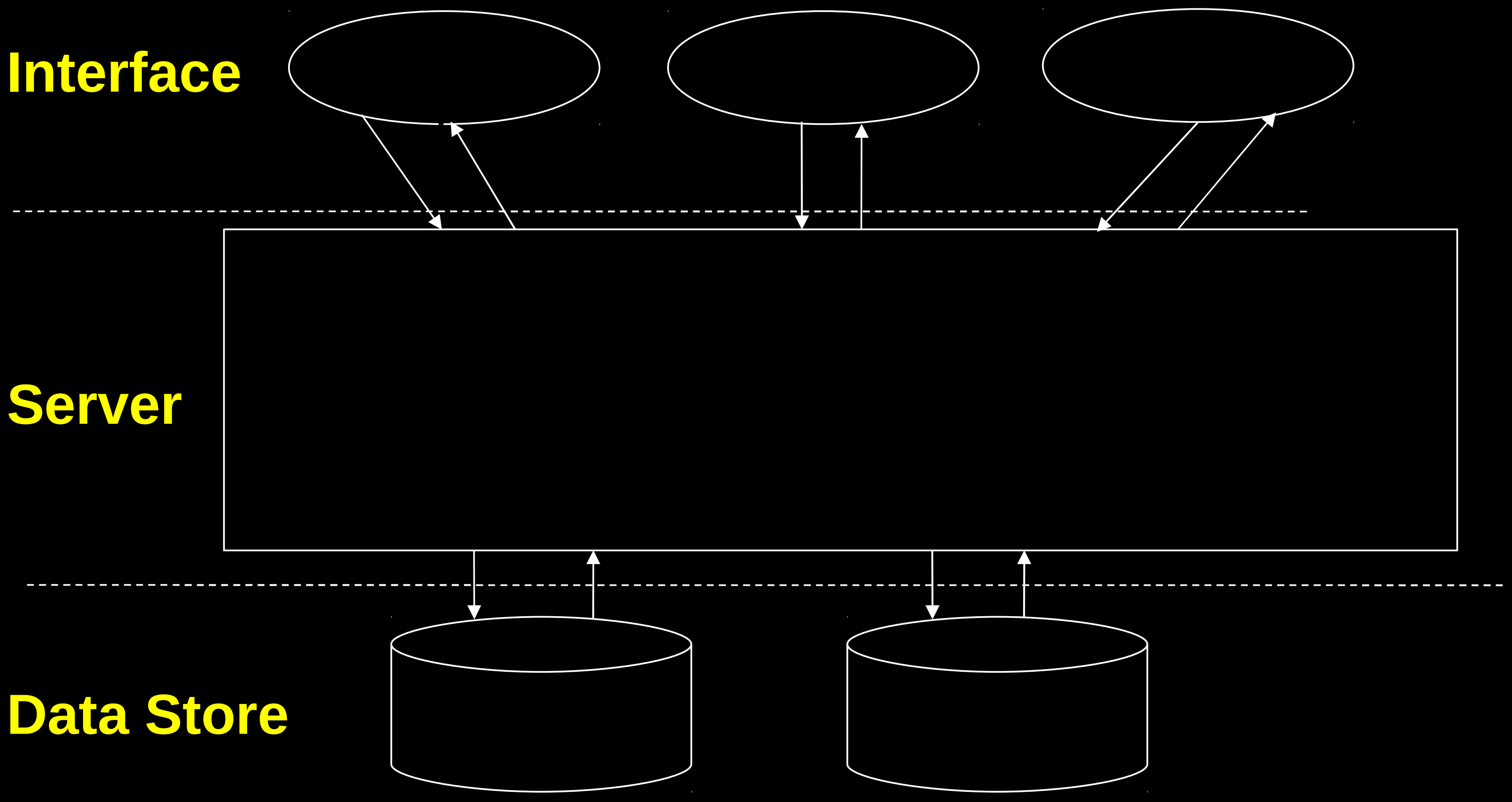
Features of New Version

- Java application
- Client-server model
- Runs on Solaris/Linux/Windows
- SSL armoured
- Interface to institution member database

Security

- SSL connection
- RMI
- Separate servers for students and staff

Architecture of Boss2



Interface

Server

Data Store

How is BOSS used?

- Two categories of user
- Student
- Staff
  - administrator
  - manager
  - moderator
  - marker

Students Submitting Work

1) Choose course
2) Choose assignment
3) Choose exercise
4) Choose program files to submit
5) Test program against *one* data set
6) If OK, submit
7) Await email receipt

Marking

1) Enter automatic test data + other criteria
2) Run (multiple) automatic tests
3) Choose weightings for tests
4) One or more persons mark
5) Lecturer moderates
6) Lecturer enters marks into database
7) Lecturer emails feedback to students
8) Lecturer prints marksheet

Module Management

- Manager can fully edit module details
  - markers/moderators
  - assignments
  - individual problems
  - deadlines
  - extensions
- Plagiarism detection

Automatic Tests

- Marks resulting from automatic tests are incorporated into the marksheet directly
- If output correct, full marks awarded
- If output wrong, 0 marks awarded
- Marker may adjust automatically assigned marks

Feedback

- Extensive commenting facility is included
- Marker can write note either for moderator or for student
- Moderator may edit feedback to student
- System emails direct to student
- Notes to moderator are confidential
- Comments and marks are retained

Anonymity

- Assignments are marked using ID numbers
- Anonymous marks are stored in a database
- List of final marks by name is produced once marking/moderation is complete

Consistency and Reliability

- Allows double (or multiple) marking on same marksheet
- Allows moderator to view both sets of marks (and original submission)
- System suggests final marks
- All automatic test results are viewed by the markers

Electronic Marksheets

- Graphical marksheet using Swing
- Lecturer specifies categories (and weights) for which marks are awarded
- Integrates marks resulting from automatic tests with those relating to style etc.

The Testing Paradigm

- Specify expected output for given input
- Compare output of student’s program
- In Boss1
  - input and output are text files
  - compare using `diff`
- In Boss2
  - input and output are Java objects
  - use `equals()` to compare
  - use `toString()` to display

Sherlock

- Plagiarism detection
  - for programs
- Compares submitted programs
  - pairwise
  - tokenised, with/without comments
  - neural net analysis
- *Indication* of possible plagiarism
  - human intervention required!

Some Dialogues

- Marker
- Module Manager

- Just to give you the feel for it!

Example marksheet

Marksheet for CS154 (2000/2001)

Module code: CS154 Module title: Demonstration

Academic year: 2000/2001 Module leader: Alfred N Other

Department: Computer Science

Year of study: 1 Course: G500 Computer Science

Surname	**Forename**	**ID**	**%**
Apple	Alice	0015624	67
Ball	Benjamin	0004563	81
Copperfield	Charlie	9956312	23
Duck	Debbie	0020114	54

Department: Mathematics

Year of Study: 2Course: G100 Mathematics

………….

Successes

- No (known!) security breaches
- Handles classes of 300+ students
- Minimal keystrokes for marking
- Easy double-marking
- Speed
- Consistency
- Anonymity
- No paperwork

Interesting Issues

- There are lots of bugs in the Sun JVM
  - processes aren’t always killed
    - sometimes servers hang under heavy load
  - Swing doesn’t work properly over ssh
    - institution network security
- RMI is slow
- Devising tests is hard
  - students *always* uncover loopholes

Future Enhancements

- Public key infrastructure
- Student access to data
  - Data Protection Act ...
- Common specification of database
  - merge with CAL software
  - single course management utility
- Incorporate developments in Java technologies

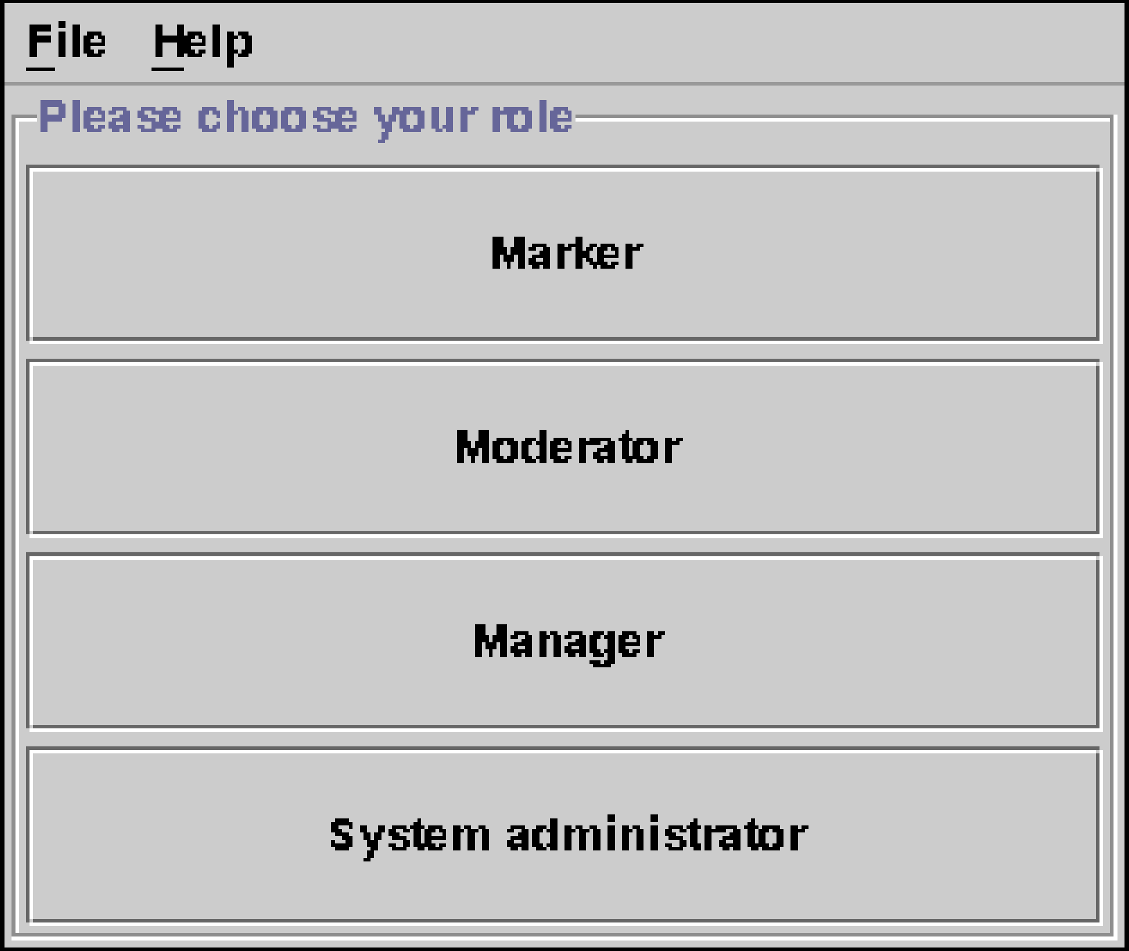
Availability

- http://www.dcs.warwick.ac.uk/cobalt/
- Documentation online
- Beta code now available

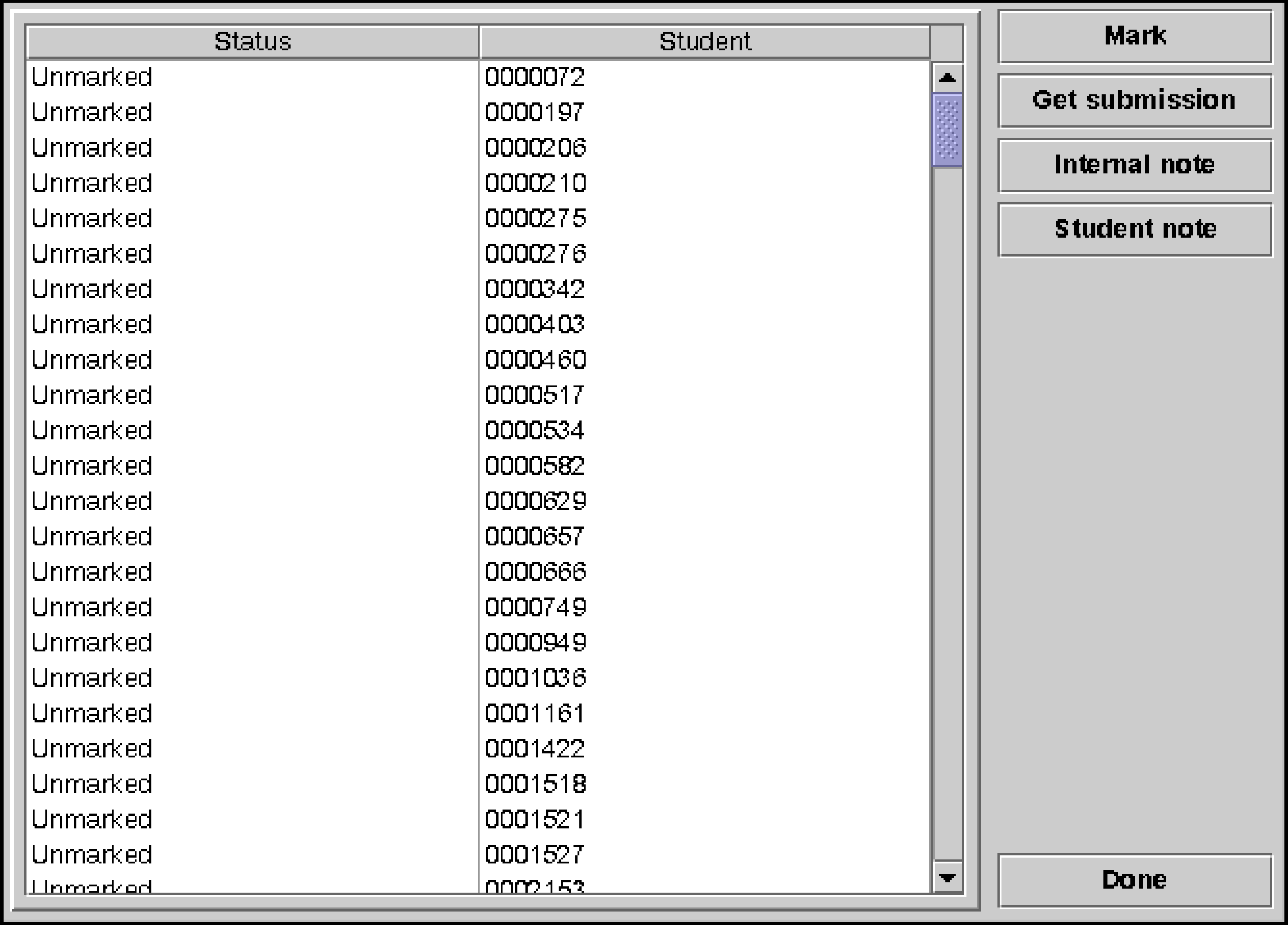
And Finally ...

Questions?

Marker Dialogue (1)

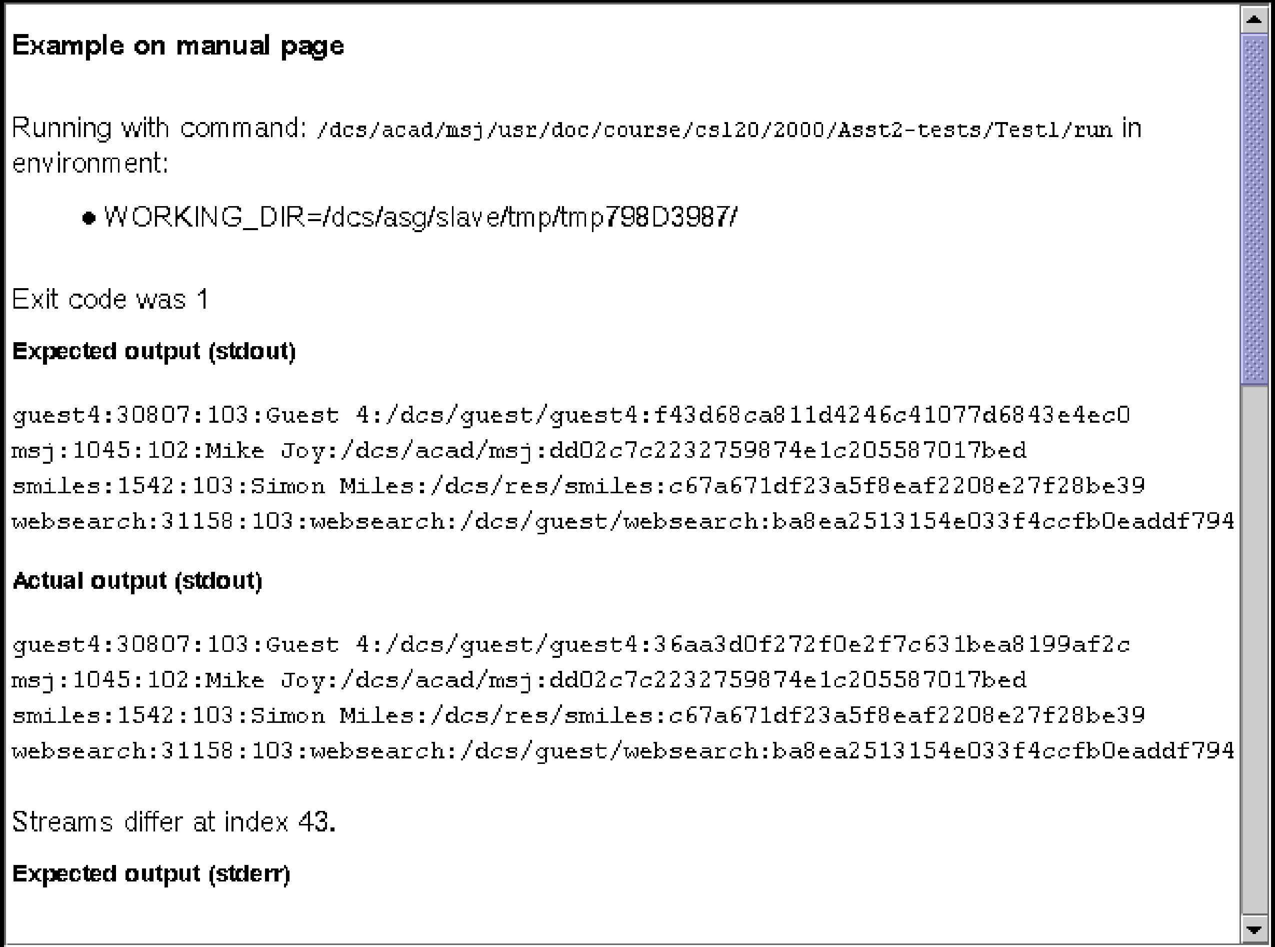


Marker Dialogue (2)



Status	Student
Unmarked	0000072
Unmarked	0000197
Unmarked	0000206
Unmarked	0000210
Unmarked	0000275
Unmarked	0000276
Unmarked	0000342
Unmarked	0000403
Unmarked	0000460
Unmarked	0000517
Unmarked	0000534
Unmarked	0000582
Unmarked	0000629
Unmarked	0000657
Unmarked	0000666
Unmarked	0000749
Unmarked	0000949
Unmarked	0001036
Unmarked	0001161
Unmarked	0001422
Unmarked	0001518
Unmarked	0001521
Unmarked	0001527
Unmarked	0002153

Marker Dialogue (3)



Example on manual page

Running with command: `/dcs/acad/msj/usr/doc/course/cs120/2000/Asst2-tests/Test1/run` in environment:

- WORKING_DIR=/dcs/asg/slave/tmp/tmp798D3987/

Exit code was 1

Expected output (stdout)

```
guest4:30807:103:Guest 4:/dcs/guest/guest4:f43d68ca811d4246c41077d6843e4ec0
msj:1045:102:Mike Joy:/dcs/acad/msj:dd02c7c2232759874e1c205587017bed
smiles:1542:103:Simon Miles:/dcs/res/smiles:c67a671df23a5f8eaf2208e27f28be39
websearch:31158:103:websearch:/dcs/guest/websearch:ba8ea2513154e033f4ccfb0eaddf794
```

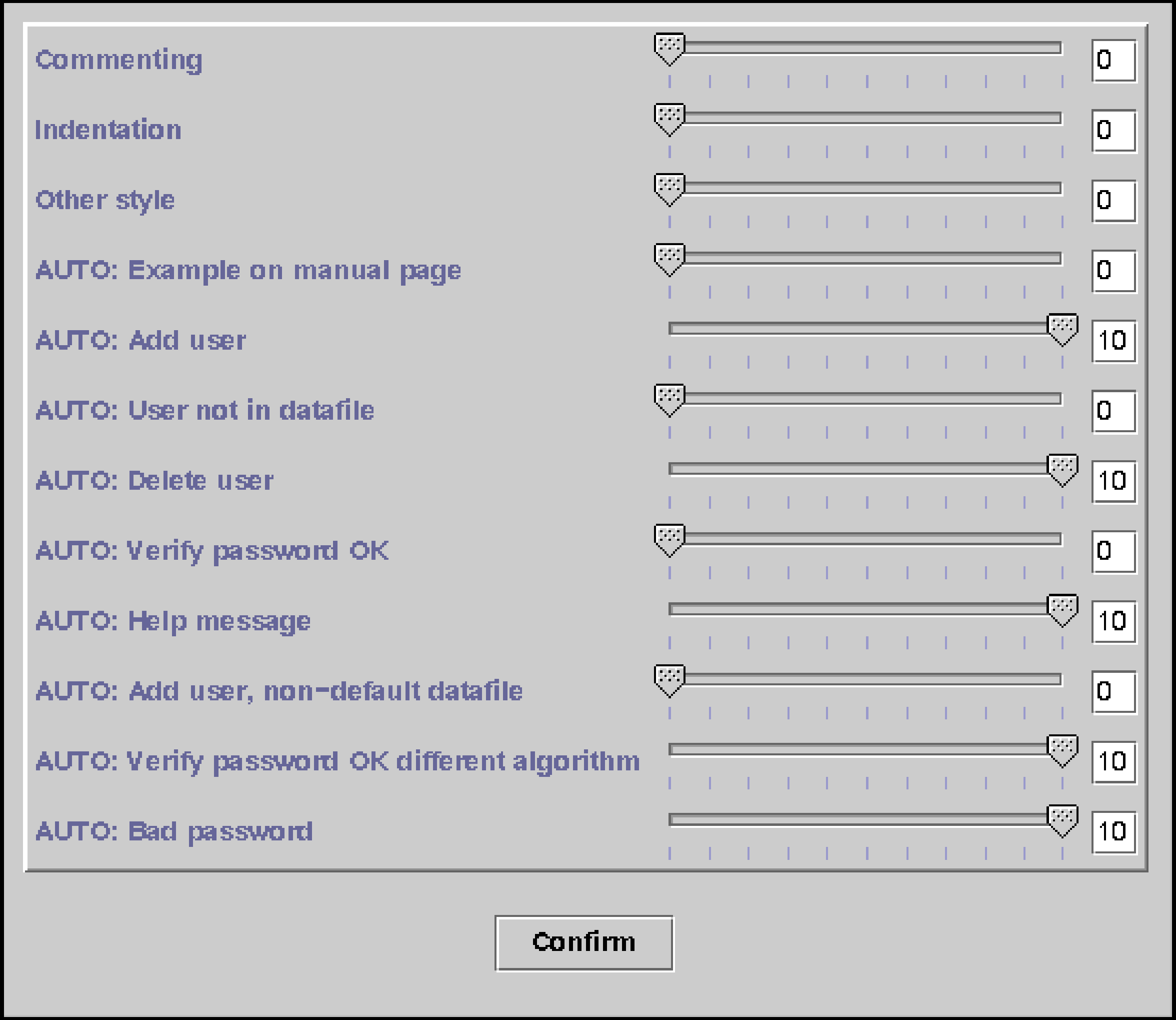
Actual output (stdout)

```
guest4:30807:103:Guest 4:/dcs/guest/guest4:36aa3d0f272f0e2f7c631bea8199af2c
msj:1045:102:Mike Joy:/dcs/acad/msj:dd02c7c2232759874e1c205587017bed
smiles:1542:103:Simon Miles:/dcs/res/smiles:c67a671df23a5f8eaf2208e27f28be39
websearch:31158:103:websearch:/dcs/guest/websearch:ba8ea2513154e033f4ccfb0eaddf794
```

Streams differ at index 43.

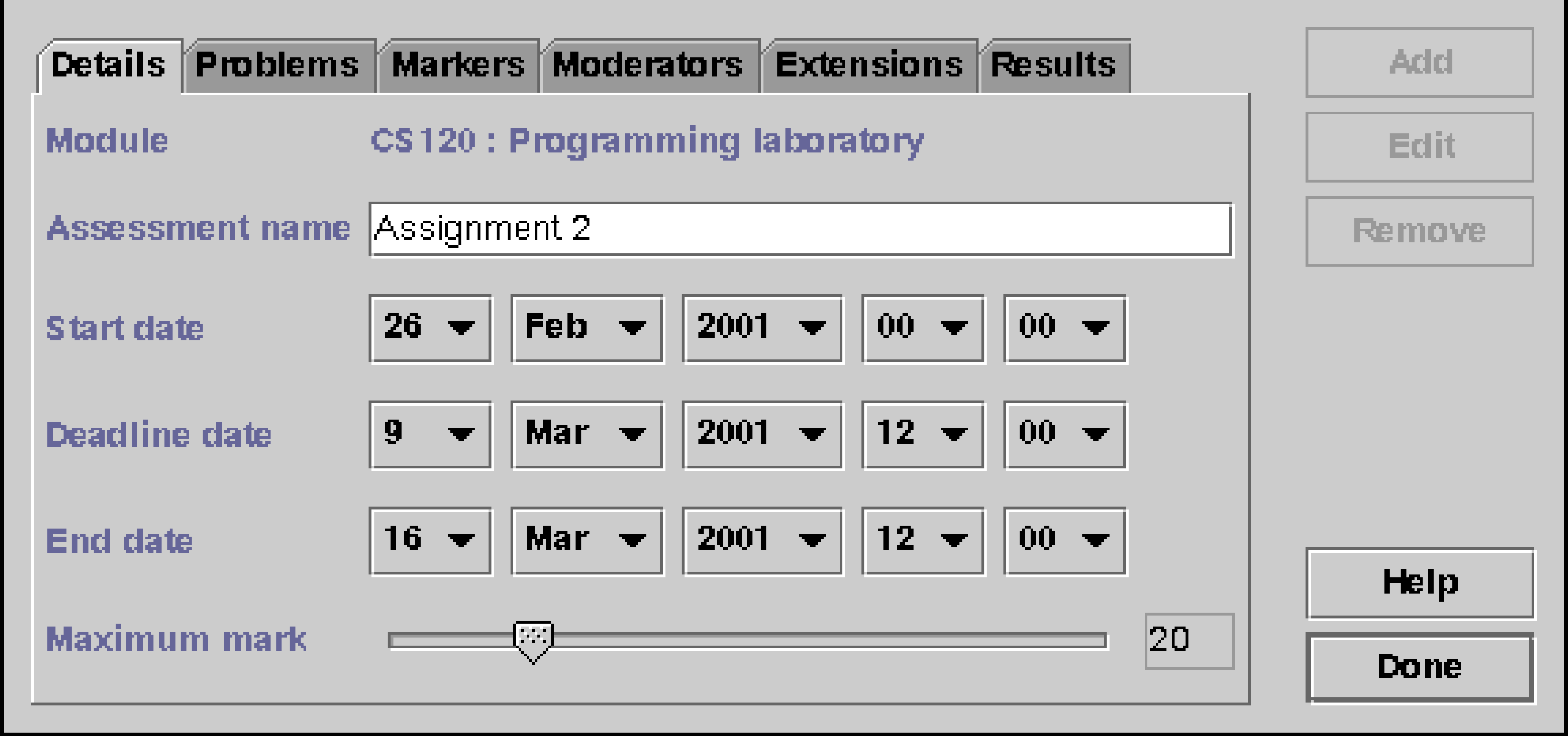
Expected output (stderr)

Marker Dialogue (4)



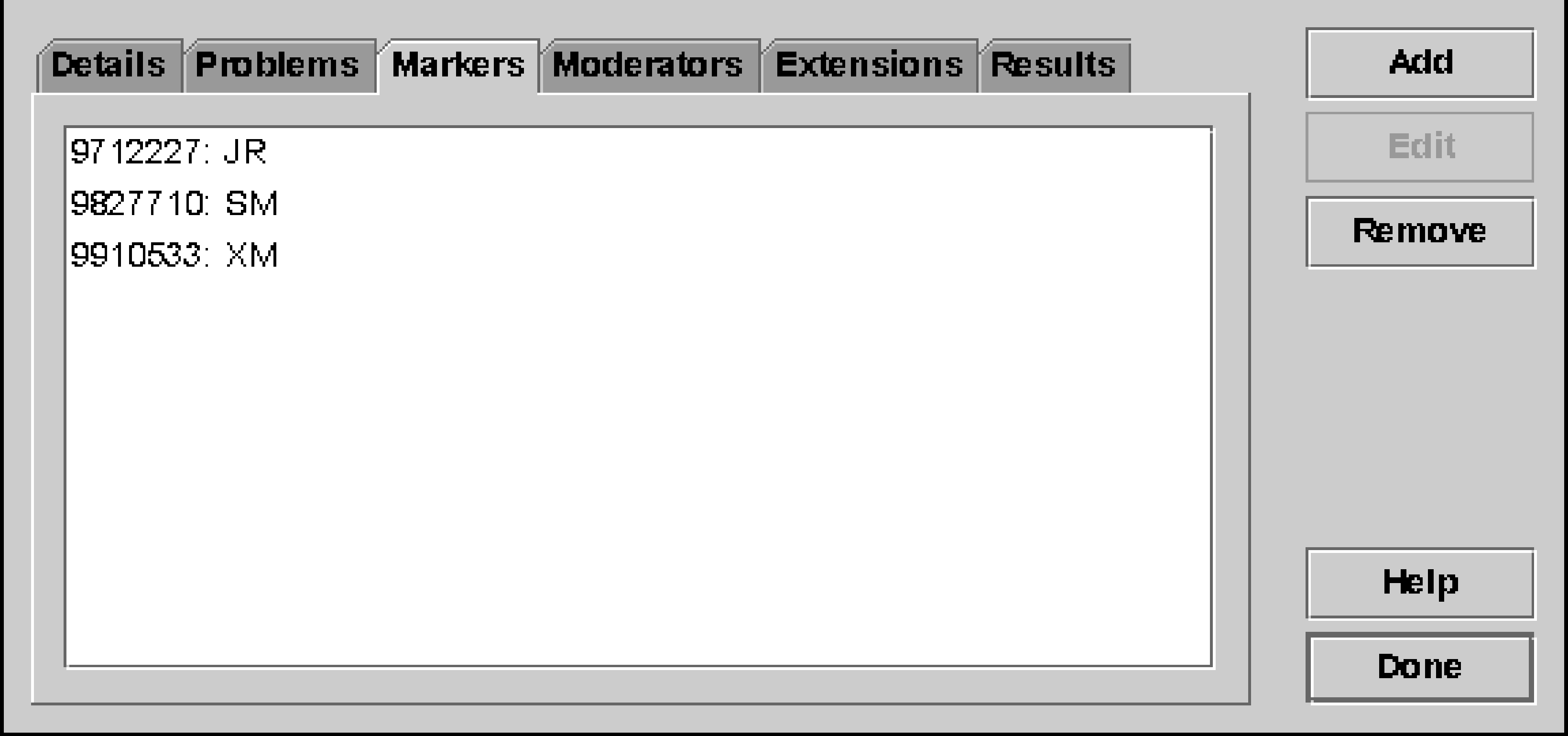
Commenting	0
Indentation	0
Other style	0
AUTO: Example on manual page	0
AUTO: Add user	10
AUTO: User not in datafile	0
AUTO: Delete user	10
AUTO: Verify password OK	0
AUTO: Help message	10
AUTO: Add user, non-default datafile	0
AUTO: Verify password OK different algorithm	10
AUTO: Bad password	10

Manager Dialogue (1)



Module	CS120 : Programming laboratory				
Assessment name	Assignment 2				
Start date	26	Feb	2001	00	00
Deadline date	9	Mar	2001	12	00
End date	16	Mar	2001	12	00
Maximum mark	20				

Manager Dialogue (2)

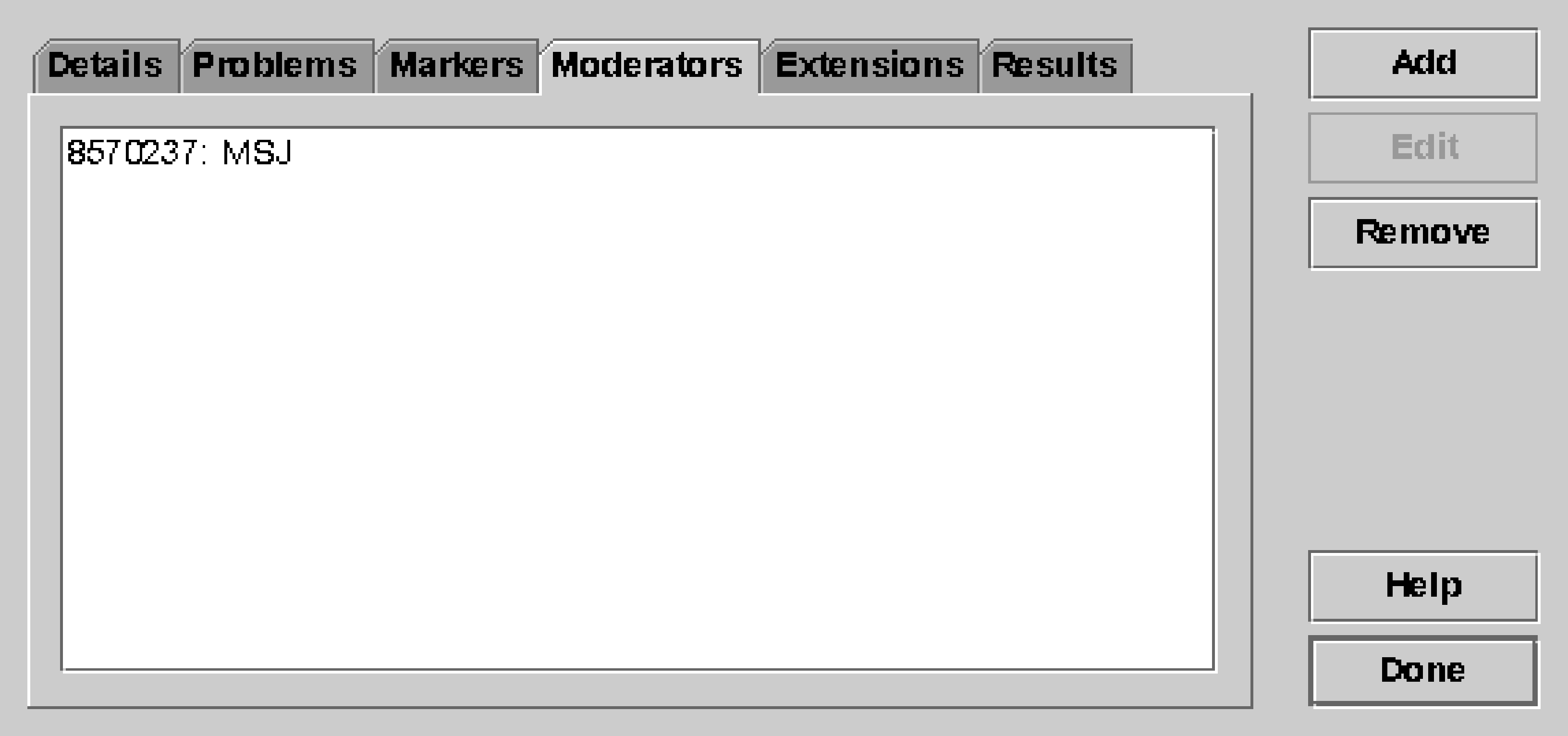


9712227: JR

9827710: SM

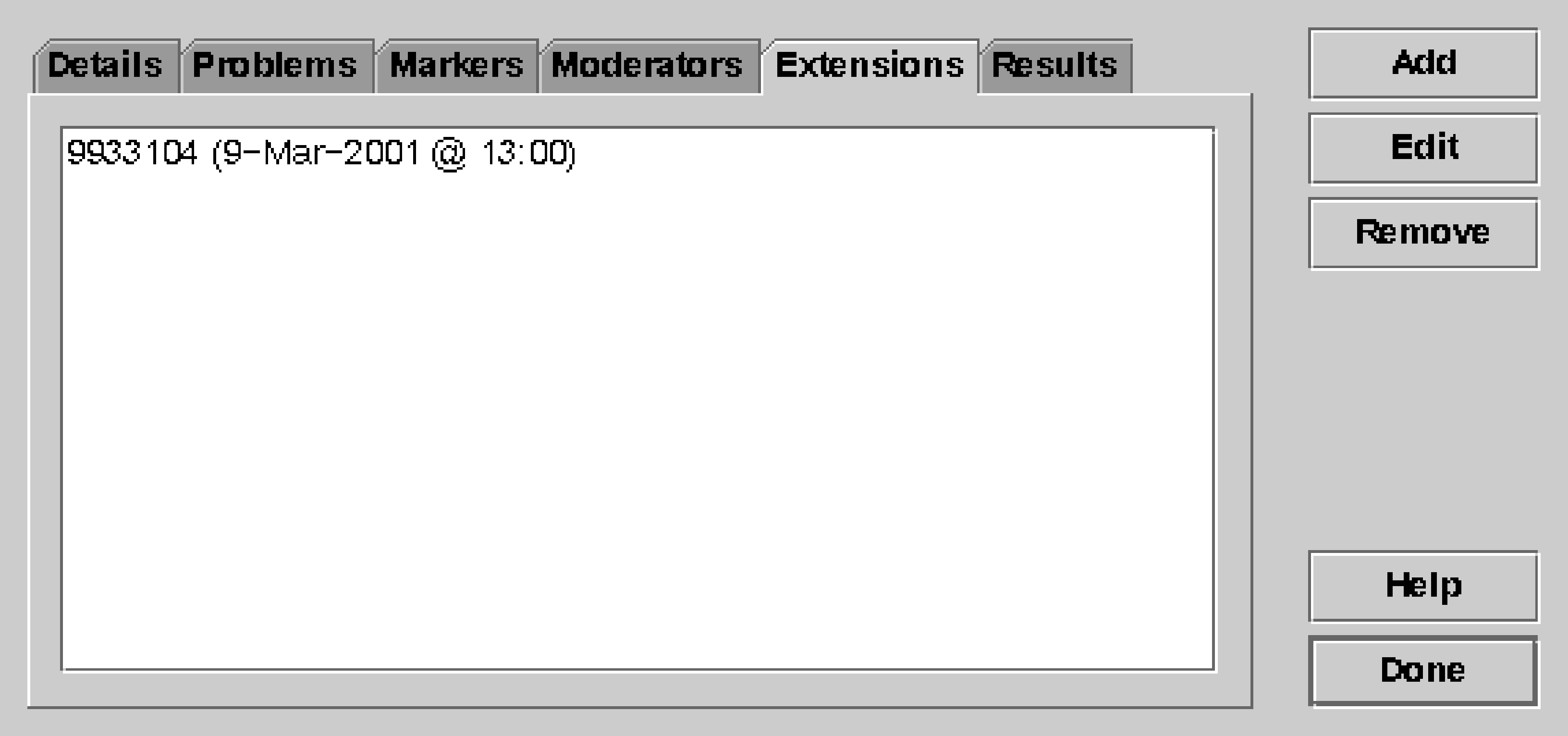
9910533: XM

Manager Dialogue (3)



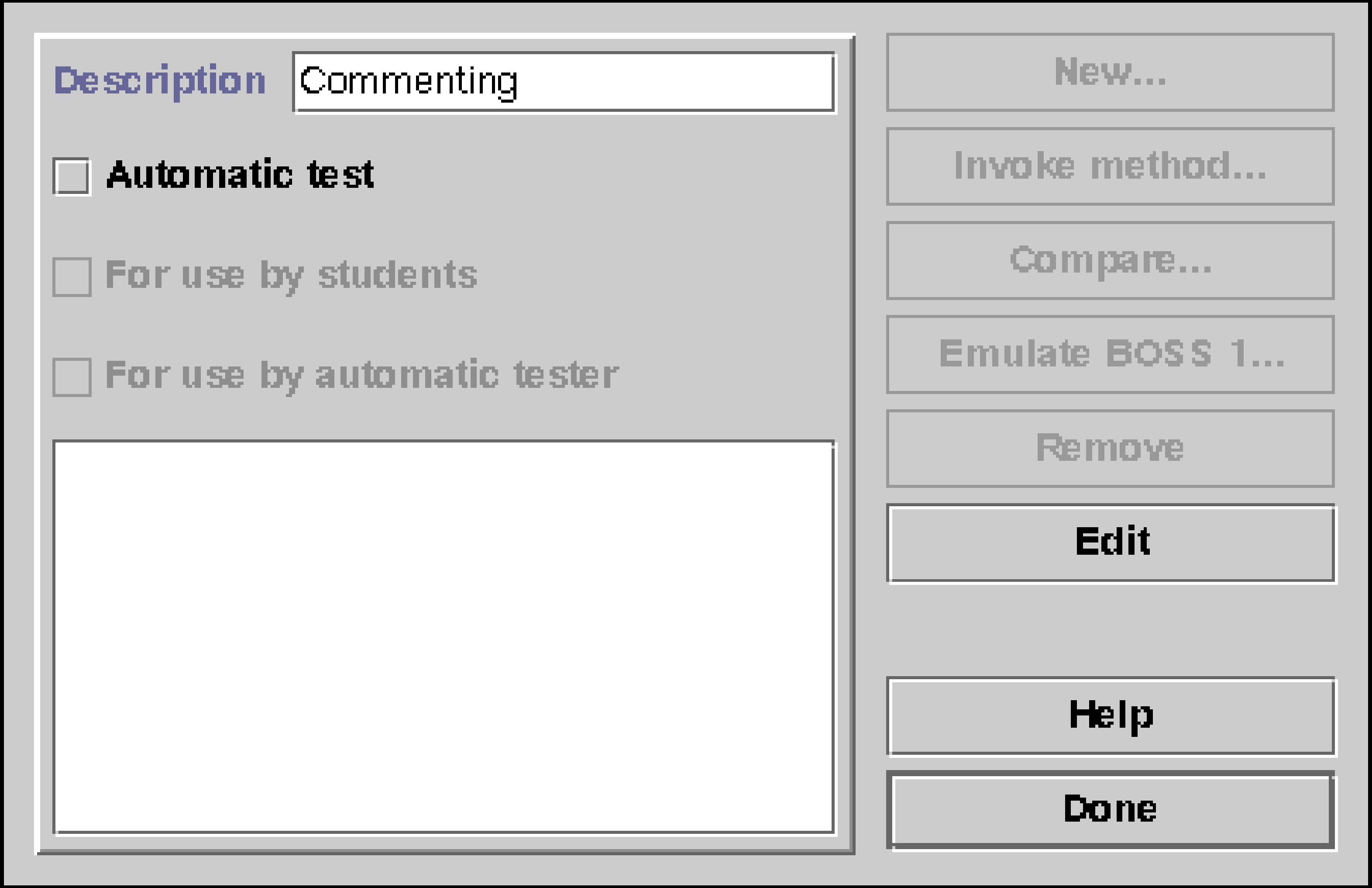
8570237: MSJ

Manager Dialogue (4)



9933104 (9-Mar-2001 @ 13:00)

Manager Dialogue (5)



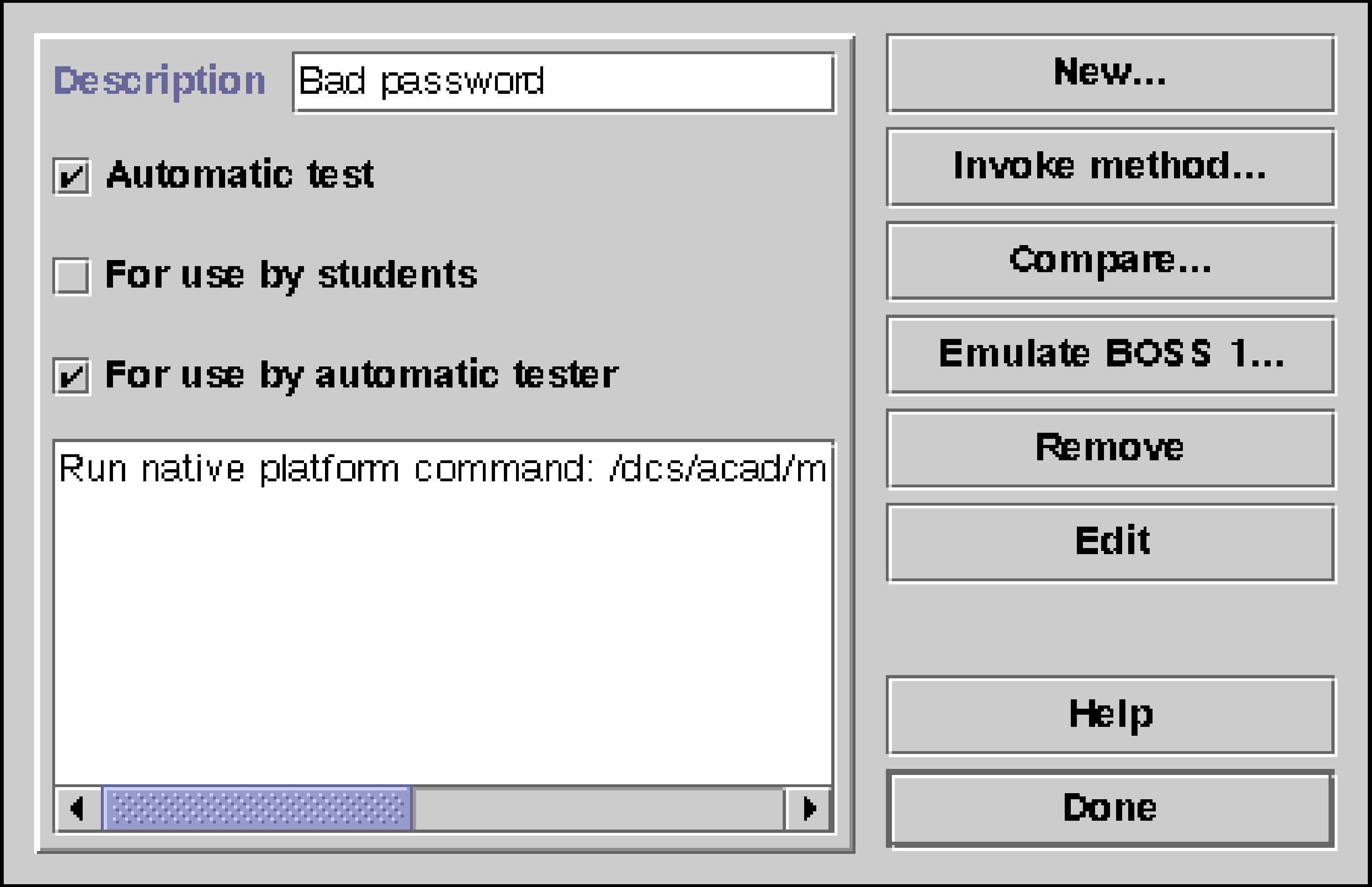
Description: Commenting

□ Automatic test

□ For use by students

□ For use by automatic tester

Manager Dialogue (6)



Description: Bad password

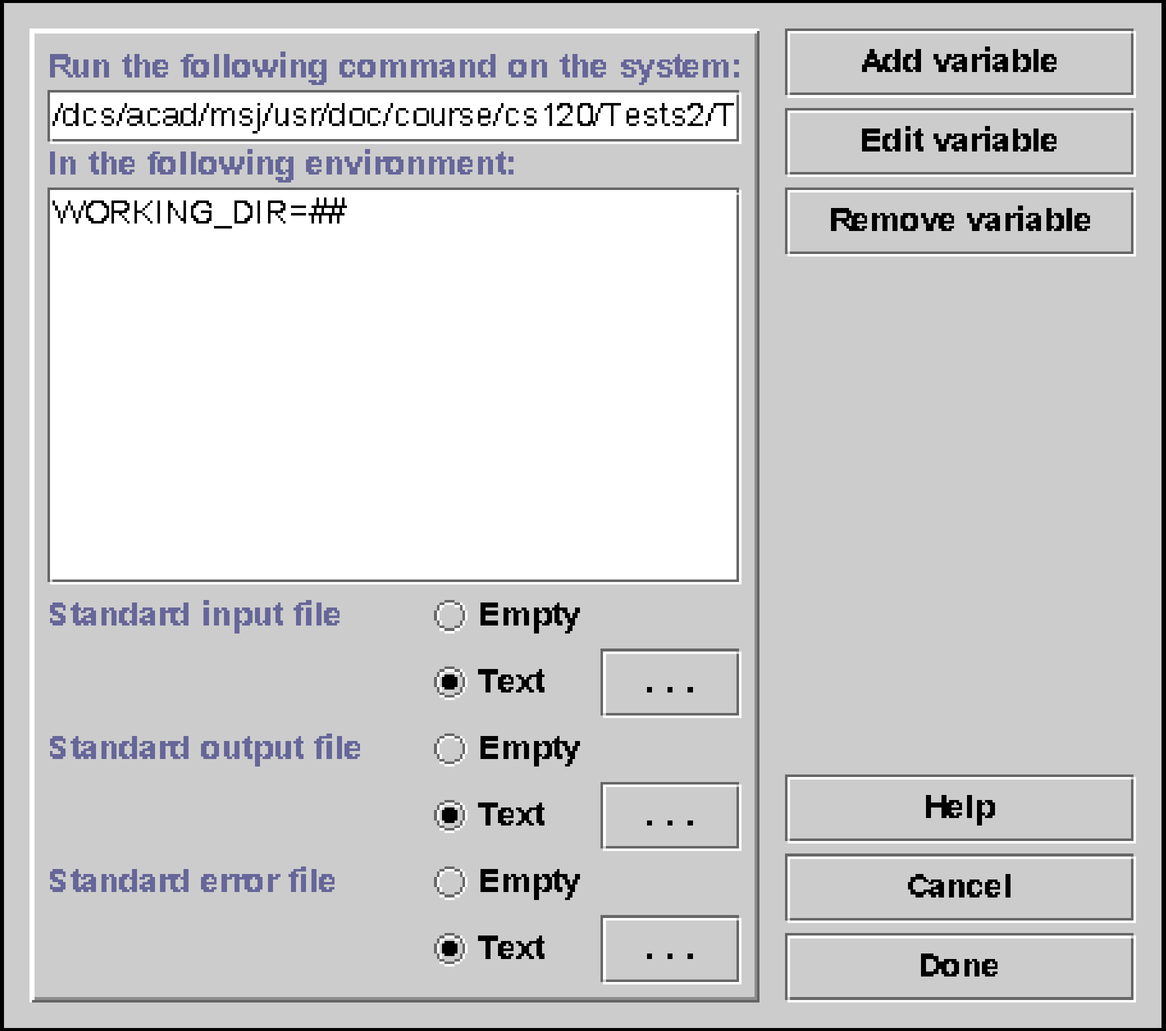
☑ Automatic test

□ For use by students

☑ For use by automatic tester

Run native platform command: /dcs/acad/m

Manager Dialogue (7)



Run the following command on the system:

/dcs/acad/msj/usr/doc/course/cs120/Tests2/T

In the following environment:

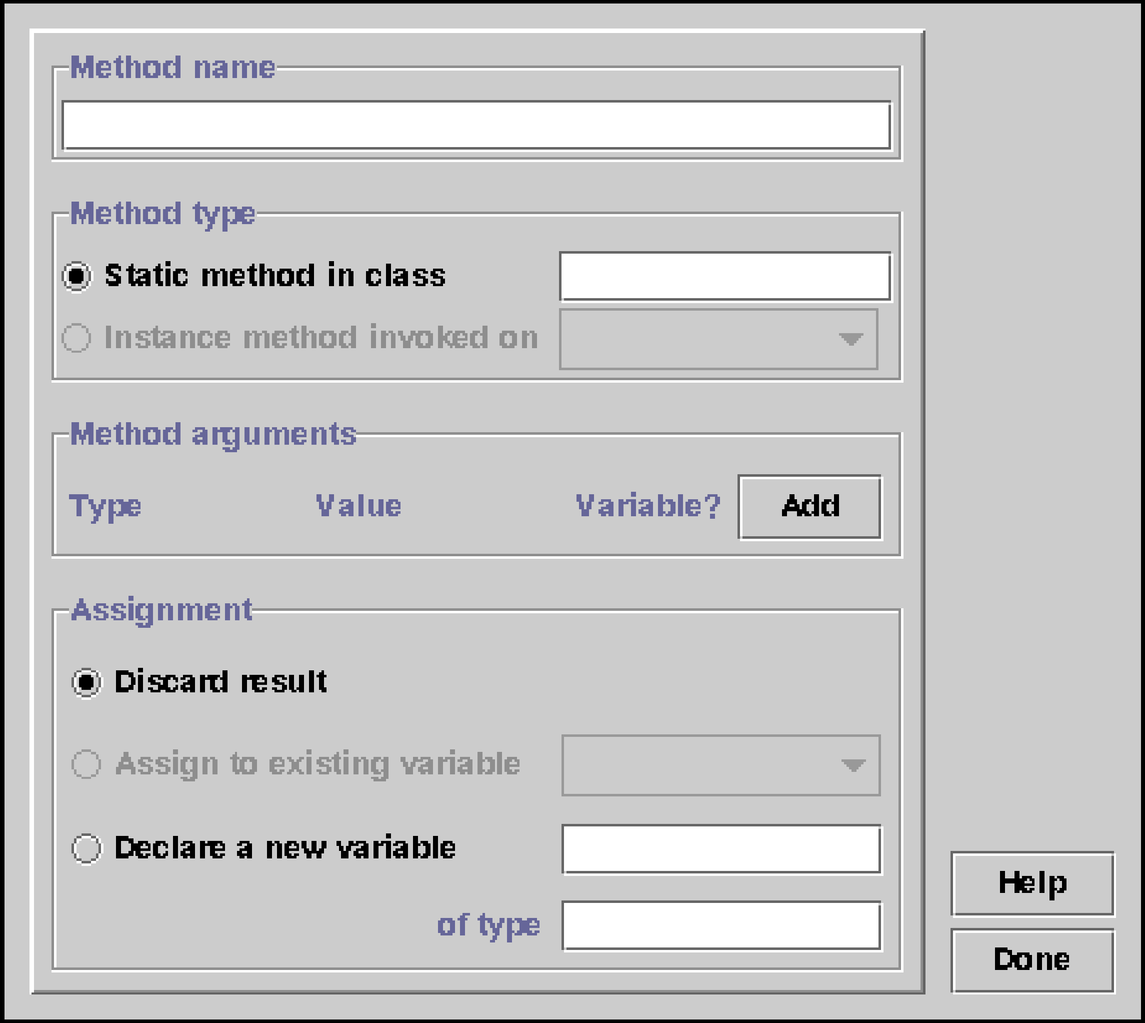
WORKING_DIR=##

Standard input file ○ Empty ● Text

Standard output file ○ Empty ● Text

Standard error file ○ Empty ● Text

Manager Dialogue (8)



Method name

Method type

● Static method in class

○ Instance method invoked on

Method arguments

Type	Value	Variable?

Assignment

● Discard result

○ Assign to existing variable

○ Declare a new variable

of type