

COMP 242 Midterm Exam

Spring 2006

There are 3 questions; answer all of them. If you need to make an assumption to clarify a problem, *write your assumption down*. Only reasonable assumptions get full credit. **Explain all answers.** The exam is worth 75 pts and you have 85 minutes to finish it. The questions are of varying difficulty; so it is probably advisable to answer the easier questions first to avoid getting stuck on the harder ones. *Good Luck!*

1. Local and Distributed Interprocess Communication (33 pts.)

Consider an operating system that supports the following operations:

```
async_send (receiver, message, msg_len)
send_wait (receiver, message, msg_len, reply_msg, reply_len)
receive_wait (message, msg_len)
reply (reply_msg, reply_len)
```

`async_send` does not wait for the message to be received; `receive_wait` waits for a message from a sender; `send_wait` waits until the receiver replies using `reply`; and `reply` is asynchronous. The sender and receiver may be on the same or different machines.

(a) Compare the two forms of send, `async_send` and `send_wait`, giving their advantages and disadvantages. (15 pts.)

(b) Consider a pair of processes, S1 and R1, that execute the following code:

S1	R1
for i := 1 to N do	for i := 1 to N do
<code>async_send</code> (R1, message, 0);	<code>receive_wait</code> (message, msg_len)
od	od

and another pair, S2 and R2, that execute the following code:

S2	R2
for i := 1 to N do	for i := 1 to N do
<code>send_wait</code> (R2, message, 0,	<code>receive_wait</code> (message, msg_len)
<code>reply_message</code> , reply_len);	<code>reply</code> (S2, reply_message, 0)
od	od

The following four experiments are performed and the times taken by the sending process to execute the loop observed:

- (1) S1 and R1 execute on the same computer. Time taken: 4 seconds.
- (2) S1 and R1 execute on different computers. Time taken: 2 seconds.
- (3) S2 and R2 execute on the same computer. Time taken: 6 seconds.
- (4) S2 and R2 execute on different computers. Time taken: 7 seconds.

Explain why experiment:

- (2) takes less time than (1)
- (3) takes more time than (1)
- (4) takes more time than (3)

If you cannot justify any of these differences, explain why not. (18 pts.)

2. Process Management (8 pts)

Outline implementations of the Xinu `suspend()` and `resume()` operations. You can ignore the fact that these operations return values. (8 pts.)

3. I/O (34 pts)

(a) Give and justify the rules to be followed while writing interrupt routines. (14 pts.)

(b) Suppose we wished to embellish Xinu with an interactive facility to suspend and resume processes: When the user enters a special "suspend character", the current process is suspended as long as it is not the null process. (The current process is the process that executes the input interrupt routine called in response to the entry of the suspend character.) When the user enters a special "resume character", the last (unresumed) process suspended by the user is resumed.

(1) Should the processing of the suspend character be done in the lower-half or upper-half of the device driver? (3pts)

(2) Should the processing of resume character be done in the lower-half or upper-half of the device driver? (3 pts.)

(3) Explain how the interrupt rules must be modified to support this facility and discuss whether this modification is safe. (6 pts.)

(4) Explain how the implementation of the Xinu terminal driver must be modified to support this facility. (8 pts.)