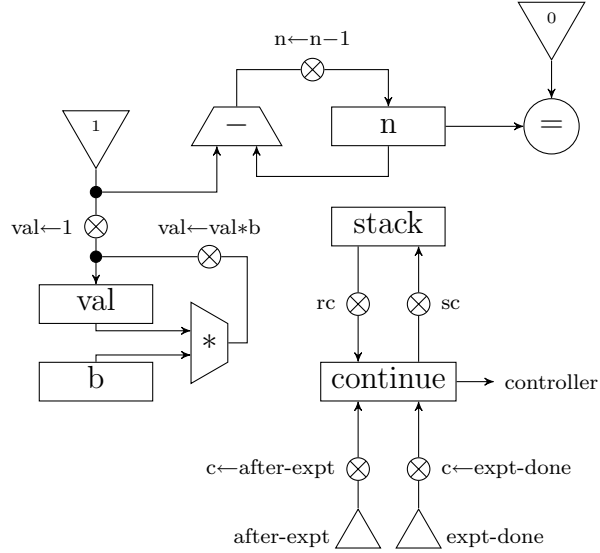
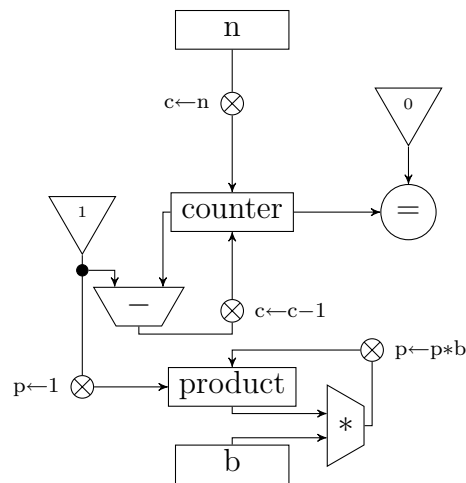


a. For the recursive exponentiation, we use the following data paths diagram



```
(controller
  (assign continue (label expt-done))
expt-loop
  (test (op =) (reg n) (const 0))
  (branch (label base-case))
  (save continue)
  (assign continue (label after-expt))
  (assign n (op -) (reg n) (const 1))
  (goto (label expt-loop))
after-expt
  (restore continue)
  (assign val (op *) (reg val) (reg b))
  (goto (reg continue))
base-case
  (assign val (const 1))
  (goto (reg continue))
expt-done)
```

b. The iterative exponentiation doesn't need a stack since the recursive call is in tail call position.



```

(controller
  (assign counter (reg n))
  (assign product (const 1))
test-counter
  (test (op =) (reg counter) (const 0))
  (branch (label expt-done))
  (assign counter (op -) (reg counter) (const 1))
  (assign product (op *) (reg product) (reg b))
  (goto (label test-counter))
expt-done)

```