

# Banking Example

```
int balance = 1000;
int main() {
    pthread_t t1, t2;
    pthread_create(&t1, NULL, withdraw, (void*)800);
    pthread_create(&t2, NULL, withdraw, (void*)800);
    pthread_join(t1, NULL);
    pthread_join(t2, NULL);
    printf("All done: balance is $%d\n", balance);
    return 0;
}
```

Imagine that these threads are created in response to requests from ATM machines

```
void* withdraw(void *arg) {
    int amount = (int)arg;
    if (balance >= amount) {
        balance -= amount;
        printf("ATM gives user $%d\n", amount);
    }
}
```

What are possible results?

# Results of Banking Example

```
$ gcc -Wall -lpthread -o bank bank.c
```

```
$ ./bank
```

ATM gives user \$800

Result 1

All done: balance is \$200

```
$ ./bank
```

ATM gives user \$800

ATM gives user \$800

Result 2

All done: balance is \$-600

How are each of  
these achieved?

```
$ ./bank
```

ATM gives user \$800

ATM gives user \$800

Result 3

All done: balance is \$200

# Schedule 1 (for Result 1)

Thread 1

Thread 2

if (`balance`  $\geq$  `amount`)  
register = `balance` - `amount`;  
balance = register

if (`balance`  $\geq$  `amount`)  
register = `balance` - `amount`;  
balance = register

time

# Schedule 2 (for Result 2)

Thread 1

Thread 2

if (`balance`  $\geq$  `amount`)  
register = `balance` - `amount`;  
balance = register

if (`balance`  $\geq$  `amount`)  
register = `balance` - `amount`;  
balance = register

time

# Schedule 3 (for Result 3)

Thread 1

Thread 2

if ( <span style="color: blue;">balance</span> >= <span style="color: green;">amount</span> )	
register = balance - <span style="color: green;">amount</span> ;	if ( <span style="color: blue;">balance</span> >= <span style="color: green;">amount</span> )
balance = register	register = balance - <span style="color: green;">amount</span> ;
	balance = register

time