EXERCISE Question on February 28th, 2023

The following is the second solution ("SOLUTION #2") for "the dining philosopher problem".

SOLUTION #2

```c
void philosopher(int i)
{
    while (TRUE)
    {
        think(); // a philosopher thinks
        take_fork(i); // grab the two forks
        eat();    // start eating
        put_forks(i); // release the forks
    }
}

void take_fork(int i)
{
    wait(MUTEX);
    state[i] = HUNGRY; // I'm hungry
    test(i);           // try to get the forks
    signal(MUTEX);
    wait(philosopher[i]); // I am eating now
}

void put_fork(int i)
{
    wait(MUTEX);
    state[i] = THINKING;  // I don't need forks
    test(LEFT);            // my left waiting for me?
    test(RIGHT);           // my right waiting for me?
    signal(MUTEX);
}

void test(int i)
{
    if ((state[i] = HUNGRY) & (state[LEFT] != EATING)
        & (state[RIGHT] != EATING))
    {
        state[i] = EATING;  // I start eating
        signal(philosopher[i]);
    }
}
```

Assume:

- N = 5
- semaphore philosopher [N]; // binary semaphore for each dining philosopher
- semaphore MUTEX;         // binary semaphore for mutex
- Each philosopher semaphore = 0; // each set to ‘0’
- The mutex semaphore = 1;   // set to ‘1’
Questions: Regarding the solution answer the following questions:

**Q1:** In “take_forks” module, what can (will) happen if “state [i] = HUNGRY” is omitted? Explain what can (will) happen and how it can (will) happen.

**Q2:** In “put_fork” module, what can (will) happen if “state [i] = THINKING” is omitted? Explain what can (will) happen and how it can (will) happen.

**Q3:** In “test” module, what can (will) happen if “state [i] = EATING” is omitted? Explain what can (will) happen and how it can (will) happen.

**Q4:** In “test” module, what can (will) happen if the “if statement“ is modified as follows:

BEFORE:

```plaintext
if (state[i] = = HUNGRY) & (state[LEFT] != EATING) & (state[RIGHT] != EATING))
```

AFTER

```plaintext
if (state[i] = = HUNGRY)
```

Explain what can (will) happen and how it can (will) happen.

**Q5:** In “take_forks” module, what can (will) happen if the mutex semaphore is not used (no “wait” and no “signal” to MUTEX)? Explain what can (will) happen and how it can (will) happen.