

# Assignment 1 COMP2111 17s1

## Odd Fibs

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This assignment is worth 16 marks and due before the end of week 5, that is, **Sunday April 2nd, 23:59:59** local time Sydney. Assignments are done in pairs.

### Problem Statement

This assignment is concerned with computing sums of odd members of certain Fibonacci-like series. Given a threshold  $t \in \mathbb{N}$ , first element  $a \in \mathbb{N}$ , and second element  $b \in \mathbb{N}$  we want to determine  $s_{t,a,b}$  as the sum of all odd  $f_n(a,b)$  satisfying  $|f_n(a,b)| < t$ , where

$$f_0(a,b) = a \tag{1}$$

$$f_1(a,b) = b \tag{2}$$

$$f_{n+2}(a,b) = f_n(a,b) + f_{n+1}(a,b) \text{ for } n \in \mathbb{N} \tag{3}$$

$$s_{t,a,b} = \sum_{k \in \mathbb{N}} \left( f_k(a,b) \cdot \begin{cases} 1 & \text{if } f_k(a,b) \text{ is odd and } f_k(a,b) < t \\ 0 & \text{otherwise} \end{cases} \right) \tag{4}$$

### Tasks

1. Specify a program that computes  $s_{t,a,b}$  assuming `t`, `a`, and `b` contain non-negative integers. The program stores the result in another variable `s`. Formally, such a specification could either a single specification statement or a pair of assertions: a precondition and a postcondition.
2. Formally derive an implementation of your specification or just guess an implementation and prove it correct.
3. Translate your implementation into a C function with the prototype as provided in `sof.h` and save it as `sof.c`. We have provided a simple test harness in `softest.c`. It can be compiled using the provided `Makefile`.
4. Describe your solutions to tasks 1–3 in a  $\text{\LaTeX}$  document that your tutor enjoys reading. In more detail:

- State clearly what the requirements are.
- Argue informally how your formal specification captures the requirements.
- Describe how you derived the implementation from the specification. List all arising proof obligations and discharge them by proof.
- Justify any changes made during the translation to C.

## Deliverables

`sof.c` C source.

`sof.tex` is a  $\text{\LaTeX}$  document with your names or student numbers mentioned in the `\author` command. It contains your task 4 solution.

## Examples

$t$	$a$	$b$	$s_{t,a,b}$
20	0	1	23
20	1	1	23
20	1	2	22
20	2	1	22
4000000	1	1	4613732
4000000	20	21	4527741
4000000	20	22	0

Examples of the interaction with your source files on CSE servers are as follows. (Our shell prompt is `$` and user input is coloured red.)

```
$ make
cc -O -Wall -Werror -c sof.c
cc -O -Wall -Werror sof.o softest.c -o softest
$ ./softest 4000000 20 21
4527741
$ make sof.pdf
:
```

## Submission Instructions

When submissions are enabled, the `give` command to be run is:

```
% 2111
% give cs2111 ass1 sof.c sof.tex
```

The command above submits the bare minimum. Should you feel the need to include more files just list them as well. Do not submit any of the provided files including the style files [2111defs.sty](#), [2111defs2.sty](#), and [2111theorems.sty](#) even if you decide to use them. If in doubt, ask on the forums.

Only one member of the pair should submit. In case there are competing submission by both members of a team, only the most recent one will be marked.