bottom up

#op	op type	tested Module	Driver	Stub	Error
1	unit	D	D_D		on D
		C	D_C		on C, D $MUS_C(D)$, $MUN_C(D)$
		B	D_B		$MUS_B(C)$, $MUN_B(C)$
		E	D_E		
		F	D_F		
		A	D_A		

S5 Floyd's method for correctness

- entry point $x_{i,j}$ $\quad P_i \overset{i \qquad j}{\longrightarrow} P_j$
- predicate

partial correctness

termination $\underbrace{x(n, v, a)}$ $\underbrace{\gamma(p)}$

1) search $(\underbrace{n, v, a}_{in}, \underbrace{p}_{out})$

$\varphi(x): v_1 \le a < v_n \wedge v_1 \le v_2 \le \dots \le v_n$

$\psi(x, z): 1 \le p < n \wedge v_p \le a < v_{p+1}$ $\quad$, $u_A := 1 + n$.

Subalg search $(\underline{n, v, a}, p)$ b $\quad$ • $A: \varphi(x)$.

$s \leftarrow 1$, $d \leftarrow n$

while $(s < d)$ do $\quad$ —— $\quad B: v_s \le a < v_d$, $u_B = d - s$.

$m \leftarrow (s+d)/2$

if $(a < v_m)$ then $d \leftarrow m$

else $s \leftarrow m+1$

$p \leftarrow s$

end Search. $\quad$ • $C: \psi(x, z)$ $\quad u_C := 0$.

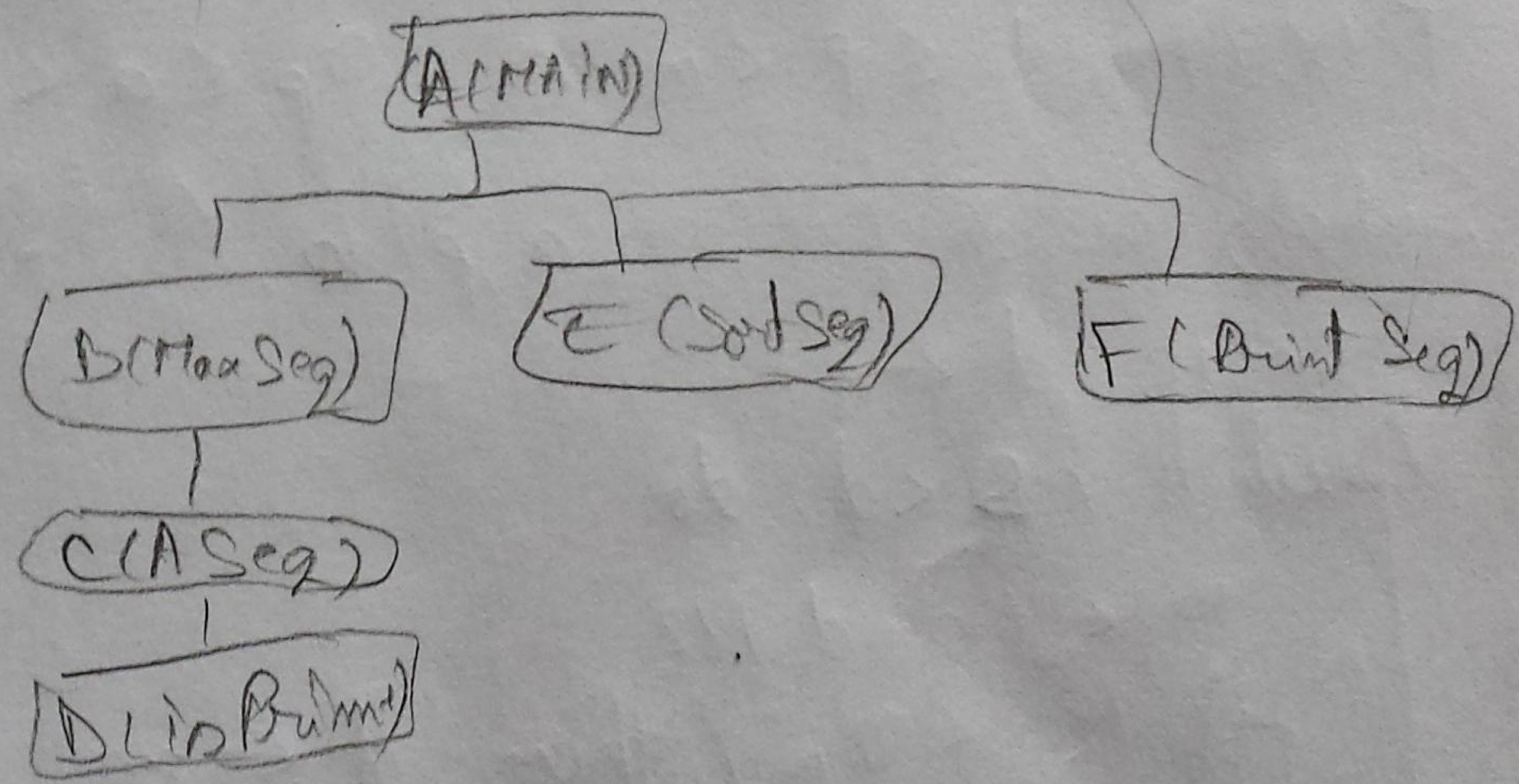
b). 2 top down < depth / breadth

#op	op type	tested module	Driver	Stub	Errors
1	unit	A	D_A	B,C,D	Err_A, $MUS_A(B,C,D)$
2	integration	B	~~D_B~~	E,F	Err_A B. MUS, $MUN_A(B)$ MUS, $MUN_B(E,F)$.
3		C	–	–	Err C ~~MUS~~, $MUN_A(C)$
4		D	–	G	Err D, $MUS_D(G)$ $MUS_A(D)$. } Also MUN.
5		E	–	–	Err E, $MUS_B(E)$.
6		F	–	–	Err F, $MUS_B(F)$
7		G			Err G $MUS_D(G)$.

c) sandwitch

applied method	#op	op type	tested module	Driver	Stub	Error
top down	1.	unit	A	–	B, C, D	E_A,
bottom-up	2	unit.	G	D_G.		E_G
	3	integr	E	D_E	–	E_E
	4		F	D_F	–	E_F.
big bang.	5	unit.	B	–	–	E_B, $MUS_B(E,F)$, $MUS_A(B)$.
	6	unit	C	–	–	E_C, $MUS_*(C)$
	7	unit	D.	–	–	E_D $MUS_D(G)$, $MUS_A(D)$.
	8	integr	B, C, D	–	–	$E_{B,C,D}$, $MUS_B(E,F)$, $MUS_D(G)$. $MUS_A(B,C,D)$

2. array of natural no.
   i) compute long. seq of prime.
   ii) sort the obtained seq.
   iii) print seq.



#op	op type	tested mod	Driver	Stub	Error
1	unit	A	D_A	B,E,F	Err A
2		B	D_B	C	Err D
3		E	D_E	–	
4		F	D_F	–.	
5		C	D_C	D	
6		D	D_D.	–	
7	integr	all	–	–	Err A, .. F $MUS_A(B,E,F)$ MUN.? $MUS_B(C)$ $MUS_C(D)$

$VC_{\alpha BC}.\ \forall x \forall y.\ v_s \le a < v_d \wedge s = d \Rightarrow 1 \le p < m \wedge \cancel{v_p \le a < v_{p+1}}$

$\wedge\ v_p \le a < v_{p+1}\ /\ (p) \leftarrow (s).$

$p = s.$

$v_p \le a < v_{p+1}.$

$v_s \le a < v_{s+1}.\ \rightarrow$ True

$TC_{\alpha AB}\ \forall x \forall y.\ v_1 \le a \le v_m \wedge v_1 \le v_2 \le \dots \le v_m \wedge s < d \rightarrow$

$1+m > d - s\ /\ (s, d) \leftarrow (1, m).\ \Leftrightarrow$

$1+m > m-1.$ (True.

$TC_{\alpha BB_1}\ \forall x \forall y.\ (v_s \le a < v_d) \wedge (s < d) \wedge (a < v_m) \rightarrow$

$\rightarrow d - s > d' - s'\ /\ (s', d') \leftarrow (s, m).$

$\left.\begin{array}{l} d - s > d' - s' \\ d' = m. \end{array}\right\} \Rightarrow d - s > m - s \Rightarrow d > m$ | True

$m = (s+d)/2$

$TC_{\alpha BB_2}\ \forall x \forall y\ (v_s \le a < v_d) \wedge (s < d) \wedge (a \ge v_m) \rightarrow$

$\rightarrow d - s > d' - s'\ /\ (s', d') \leftarrow (m, d)$

$\left.\begin{array}{l} d - s > d' - s' \\ s' = m \end{array}\right\} \Rightarrow d - s > d - m \Leftrightarrow s < m.$ (T)

$TC_{\alpha BC}\ \forall x \forall y\ v_s \le a < v_d \wedge s = d \rightarrow d - s > 0.\ /\ p \leftarrow s$

$\Leftrightarrow 0 > 0$ False

$R_{\alpha AB} ::= s < d$

$R_{\alpha BB_1} ::= (s < d) \wedge (a < v_m)$

$R_{\alpha BB_2} ::= (s < d) \wedge (a \geq v_m)$

$R_{\alpha BC} ::= \neg(s < d) \cong s \geq d \Rightarrow s = d$

$r_{\alpha AB} ::= (s, d) \leftarrow (1, m)$

$r_{\alpha BB_1} ::= (s, d) \leftarrow (s, m)$

$r_{\alpha BB_2} ::= (s, d) \leftarrow (m, d)$

$r_{\alpha BC} ::= (p) \leftarrow (s)$

$VC_{\alpha AB}$ $\forall x \forall y.\ v_1 \leq a < v_m \wedge v_1 \leq v_2 \leq \ldots \leq v_m \wedge s < d \rightarrow$
$\rightarrow (v_s \leq a < v_d)$ / $(s, d) \leftarrow (1, m)$.

$$\left.\begin{array}{l} s = 1,\ d = m \\ v_1 \leq a < v_m \end{array}\right\} \Rightarrow v_s \leq a < v_d.$$

$VC_{\alpha BB_1}$ $\forall x \forall y.\ (v_s \leq a < v_d) \wedge (s < d) \wedge (a < v_m) \rightarrow v_s \leq a < v_d$ / $r_{\alpha BB_1}$ $(s, d) \leftarrow (s, m)$.

$$\left.\begin{array}{l} v_s \leq a < v_d \\ s = s,\ d = m \end{array}\right\} \Rightarrow v_s \leq a < v_m$$

$VC_{\alpha BB_2}$, $\forall x \forall y\ ((v_s \leq a < v_d) \wedge (s < d) \wedge (a \geq v_m)) \overset{?}{\rightarrow}$
$\rightarrow (v_s \leq a < v_d)$. // $(s, d) \leq (m, d)$

$$\left.\begin{array}{l} s = m,\ d \\ v_s \leq a < v_d \end{array}\right\} \Rightarrow v_m \leq a < v_d.$$

2) $gcd(m_1, m_2, d)$

$\varphi(x) : m_1 \in N \wedge m_2 \in N.$

$\psi(x,z) := d = gcd(m_1, m_2).$

Subalg $gcd(m_1, m_2, d)$ is

$d \leftarrow m_1$, $i \leftarrow m_2$

while $(d \neq i \ \& \ i > 0)$ do

if $(d > i)$ then $d \leftarrow d - i$

else $i \leftarrow i - d.$

$A : \varphi(x)$

$u_A : 2m_1 + 2m_2$

$B : (d, i) = (m_1, m_2).$

Remark $(a, b) = gcd(a, b)$

$u_B : d + i.$

$C \ \psi(x,z) \quad u_C := 0.$

$r_{\alpha AB}. \ (d, i) \leftarrow (m_1, m_2)$

$r_{\alpha BB_1} \ d \leftarrow d - i.$

$r_{\alpha BB_2} \ i \leftarrow i - d$

$BC \quad \emptyset.$

$R_{\alpha AB} \ d \neq i \wedge i > 0$

$BB_1 \ d \neq i \wedge i > 0 \wedge d > i.$

$BB_2 \ d \neq i \wedge i > 0 \wedge d \leq i.$

$BC \ \neg(d \neq i \wedge i > 0) \equiv d = i \vee i \leq 0.$

$v_{C \alpha AB} : \forall x \forall y \ m_1 \in N \wedge m_2 \in N. \wedge d \neq i \wedge i > 0 \rightarrow .(d, i) = (m_1, m_2) / r_{\alpha AB}$

$v_{C \alpha BB_1} \ (d, i) = (m_1, m_2) \wedge d \neq i \wedge i > 0 \wedge d > i \rightarrow (d', i) = (m_1, m_2) / d' \leftarrow d - i$

$(d - i, i) = (m_1, m_2)$ true

$v_{C \alpha BB_2} \ (d, i) = (m_1, m_2) \wedge d \neq i \wedge i > 0 \wedge d \leq i. \rightarrow (d', i') = (m_1, m_2) / i' \leftarrow i - d$

$\rightarrow (d', i - d) = (m_1, m_1)$ true

$v_{C \alpha BC} . (d, i) = (m_1, m_2) \wedge d = i \vee i \leq 0. \rightarrow . d = (m_1, m_2)$ true

$d = (d, d) = (m_1, m_2)$