Part 1.

$$T(n) = 1 + 2 \cdot T\left(\frac{n}{2}\right)$$

$$= 1 + 2 \cdot \left(1 + 2 \cdot T\left(\frac{n}{2^2}\right)\right)$$

$$= 1 + 2 \cdot (1 + 2 \cdot (1 + \ldots T\left(\frac{n}{2^h}\right)))$$

$$= 1 + 2 + 2^2 + \cdots 2^h \qquad \text{where } 2^h \doteq n.$$

$$h = \log_2 n.$$

$$= 1 \cdot \frac{2^{h+1} - 1}{2 - 1} = 2 \cdot 2^h - 1$$

$$= 2 \cdot n - 1 \quad (\because 2^h = 2^{\log_2 n} = n)$$

Part 2.

if) $m \geq 0$

$$T(rf_2(m)) = 1 + T(rf_2, m-1)$$

$$= 1 + \cdots + T(rf_2, 0) = m+1.$$

$$T(rf_1, n) = 1 + T(rf_2, n-1) + T(rf_1, n-1)$$

$$= (1+n) + ((1+n-1) + T(rf_1, n-2))$$

$$= (1+n) + n + (n-1) + \cdots + T(rf_1, 0)$$

$$= (1+n) + n + (n-1) + \cdots + 1$$

$$= \frac{(n+1)(n+2)}{2}.$$

Trace of data1.

			rf2
$n=5$.	(9, 3, 1, 7, 4)	→ (3, 1, 7, 4, 9)	: 4 swap, 5 runs
$n=4$	(3, 1, 7, 4, 9)	→ (1, 3, 4, 7, 9)	: 2. swaps, 4 runs
$n=3$	(1, 3, 4, 7, 9)	→ (1, 3, 4, 7, 9)	: 0 swaps. 3 runs
$n=2$	(1, 3, 4, 7, 9)	→ (1, 3, 4, 7, 9)	: 0 swaps. 2 runs
$n=1$.	(1, 3, 4, 7, 9)	→ (1, 3, 4, 7, 9)	: 0 swaps, 1 run.
$n=0$	(1, 3, 4, 7, 9)		: 0 swaps. 0 run

↓ denotes 'data' pointer. ↗ denotes rf2 call

total runs = 6 + (1+2+ ·· +5) = 21

$$T(rf_1, 5) = \frac{6 \cdot 7}{2} = 21.$$