$\boxed{1}$ $F = \{\pm m/\beta^t \cdot \beta^e \mid \beta^{t-1} \le m \le \beta^t, m \in \mathbb{Z}, e \in \mathbb{Z}\}$.

As written in the textbook, we can restrict the range of m in order to make 1-1 correspondence between floating pt & IEEE representation.

So, the gap size between each floating pts is $1/\beta^t \cdot \beta^e = \beta^{e-t}$.

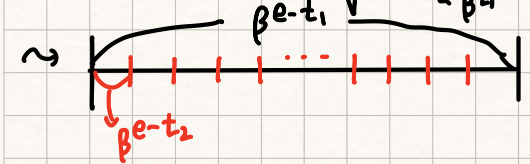
Let F_1, F_2 be F with single precision t_1 & double precision t_2, respectively.

Single: $t_1 = 24$ Double: $t_2 = 53$

Let any IEEE single precision # $\frac{m}{\beta^{t_1}} \times \beta^e$ be given. $(\beta^{t_1-1} \le m \le \beta^{t_1}-1)$ (WLOG, let's consider positive #)

Now we are considering the $[\frac{m}{\beta^{t_1}} \times \beta^e, \frac{m+1}{\beta^{t_1}} \times \beta^e]$. Note that $\frac{m}{\beta^{t_1}} \times \beta^e = \frac{m\beta^{t_2-t_1}}{\beta^{t_2}} \times \beta^e \in \mathbb{F}_2$ as $\beta^{t_2-1} \le m\beta^{t_2-t_1} \le \beta^{t_2}-1$

$\rightsquigarrow$



So, # of double precision numbers including the endpts is $\beta^{e-t_1}/\beta^{e-t_2}+1 = \beta^{t_2-t_1}+1$.

$\therefore$ Between a pair of adjacent single precision numbers (so, excluding endpts), there are $\beta^{29}-1$ double precision #s.

$\boxed{2}$ (a) For $n = 1, 2, \cdots, \beta^t$, it is representable as $0.1d_2\cdots d_t \times \beta^e$ is our elements of F.

So, we can not represent the binary number more than t digits: $\underbrace{10\cdots0}_{t}1 = \beta^t+1$.

Note that β^t is representable.

(b) substitute t as 24 & 53

(c) construct $2^t-4, 2^t-3, 2^t-2, 2^t-1, 2^t, 2^t+1, 2^t+2, 2^t+3, 2^t+4$

gaps: 1, 1, 1, 1, 0, 2, 2, 0 ($2^t+1 \approx 2^t$, $2^t+3 \approx 2^t+4$)

$\overbrace{10\cdots0}^{t}1 \rightsquigarrow \overbrace{10\cdots0}^{t}0$

$\underbrace{10\cdots1}_{t}1 \rightsquigarrow \underbrace{10\cdots1}_{t}0$

Note that 2^t+2 representable, so gap between n must be 2 as $fl(2^t+1) = 2^t$.

& calculate the gap. If num representable, gap must be 1.