min (max (pair sums))

$a_1 \le a_2 \le a_3 \le a_4 \le a_5 \le a_6$

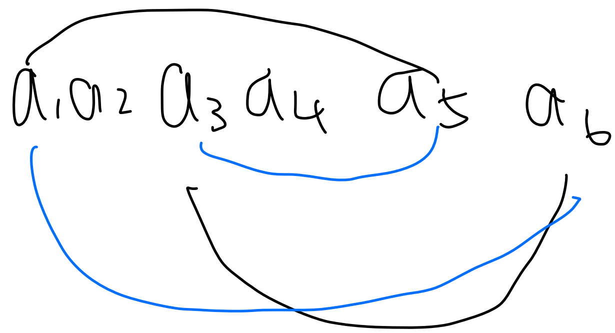
$\uparrow$

$\frac{n}{2}$ pairs

Prove : Greedy choose (smallest, largest)
will not be worse

suppose:

a_6 is paired with a_i
and a_1 is paired with a_j



Now we swap their pairing

$$\begin{matrix} (a_6, a_i) \\ (a_1, a_j) \end{matrix} \Longrightarrow \begin{matrix} (a_6, a_1) \\ (a_i, a_j) \end{matrix}$$

Observe:

① $a_6 + a_i \ge a_6 + a_1$ $\quad (\because a_i \ge a_1)$

② $a_6 + a_i \ge a_j + a_i$ $\quad (\because a_6 \ge a_j)$

③ $\max(a_6 + a_i, a_1 + a_j) \ge a_6 + a_i$ $\quad$ (by definition)

$\Rightarrow$ ①, ②, ③, $\max(a_6 + a_i, a_1 + a_j)$

$$\geq a_6 + a_i \geq \max(a_6 + a_1, a_j + a_{\bar{i}})$$