ECE 420 Assignment 3
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1. 1) O(n^3)
   2) Msg size: n^2/p

   communication t: $\log\sqrt{p} * t_s + \left(\sqrt{p}-1\right)\frac{n^2}{p} * t_w$

   computation t: $\sqrt{p} * \left(\frac{n}{\sqrt{p}}\right)^3 = \frac{n^3}{p}$

   parallel run time: $T_p = \frac{n^3}{p} + 2 * \left(\log\sqrt{p} * t_s + \left(\sqrt{p}-1\right)\frac{n^2}{p} * t_w\right)$

   3) cost: $T_p p = n^3 + 2p\log\sqrt{p} * t_s + 2\left(\sqrt{p}-1\right)n^2 * t_w$
   optimal: p = O(n^2)
2. Time cost for each: $t_s + t_w m$
   time cost total: $\log p * (t_s + t_w m)$
3. Size of one msg: $2^{i-1} * m$
   time for each (i is one element from $\log p$): $t_s + t_w * 2^{i-1} m$

   time total: $\sum_i^{\log p} t_s + t_w * 2^{i-1} m = \log p * t_s + (p-1) t_w m$

4. Definite unsafe for unbuffered send, may be safe for buffered send

1) Process0	Process1
Send→Pro1	Receive←Pro0
Receive←Pro1	Send→Pro0
2) Process0	Process1
Isend→Pro1	Isend→Pro0
Irecv←Pro1	Irecv←Pro0
Wait	Wait
3) Process0	Process1
Sendrecv↔Pro1	Sendrev↔Pro0

5. (1) Parallel run time: $T_p = \frac{n^2}{p} t_c + \left(\log p * t_s + (p-1)\frac{n}{p} * t_w\right)$

   cost: $T_p p = t_c n^2 + p\log p * t_s + n(p-1) t_w$

   (2) Parallel run time: $T_p = \frac{n^2}{p} t_c + \left(\log p * (t_s + n * t_w) + (p-1)(t_s + \frac{n}{p} * t_w)\right)$

   cost: $T_p p = n^2 t_c + (p\log p * (t_s + n * t_w) + (p-1)(p * t_s + n * t_w))$

   (3) Parallel run time: $T_p = \frac{n^2}{p} t_c + \left(t_s + \frac{n}{\sqrt{p}} t_w\right) + 2 * \left(t_s + \frac{n}{\sqrt{p}} t_w\right)\log\sqrt{p}$

   cost: $T_p p = n^2 t_c + \left(p * t_s + n\sqrt{p} * t_w\right) + 2 * \left(p * t_s + n\sqrt{p} * t_w\right)\log\sqrt{p}$
   (4) cost: $T_p p = n^2 t_c + p\log p\,(t_s + n t_w)$

6. Parallel run time: $T_p = \Theta\left(\frac{n^2}{p^2}\right) + 2 * \Theta(\mathrm{n})$

   cost: $\Theta\left(\frac{\mathrm{n}^2}{p}\right) + 2 * \Theta(\mathrm{np})$

   optimal:$p = O(\sqrt{n})$