P11.1.1

Solve $Ux = b$, x, b are dense., needs to access U by column in CSC form.

$$
\begin{array}{c}
\begin{array}{cc} \quad n-1 & \quad 1 \end{array} \\
\begin{array}{c} n-1 \\ 1 \end{array}
\begin{bmatrix} U_{11} & u_{12} \\ & u_{22} \end{bmatrix}
\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}
\begin{array}{c} n-1 \\ 1 \end{array}
=
\begin{bmatrix} b_1 \\ b_2 \end{bmatrix}
\begin{array}{c} n-1 \\ 1 \end{array}
\end{array}
$$

① $U_{11}x_1 + U_{12}x_2 = b_1$

② $u_{22}x_2 = b_2$

Solve $x_2 = b_2/u_{22}$, then $U_{11}x_1 = (b_1 - U_{12}x_2)$

unrolling the recursion:

$x = b$ ← b can overwrite x.

for $j = n$ down to 1

$\quad x(j) = x(j)/u(j,j)$

$\quad x(1:j-1) = x(1:j-1) - u(1:j-1, j) \cdot x(j)$.

if U sparse, only do this if $u_{ij} \neq 0$.

P11.1.2

Yes, the sparse outer-product update is an $O(nnz(u) \cdot nnz(v))$ computation. Because there are 2 for loops in the alg.. we need to go through indexing β and α.

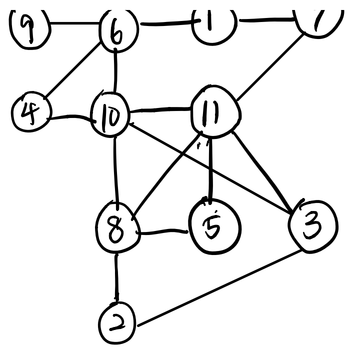
for $\beta = 1:nnz(v)$

$\quad$ for $\alpha = 1:nnz(u)$

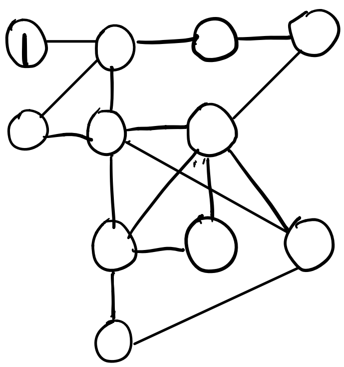
$\quad\quad$ ....

P11.1.5

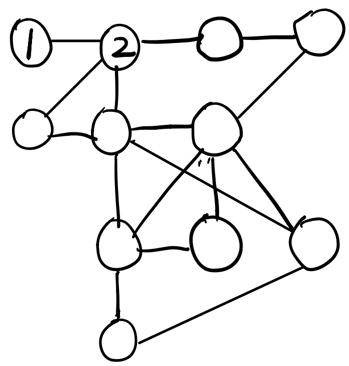
(a)



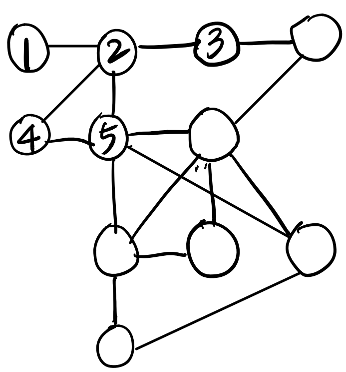
Original G_A.



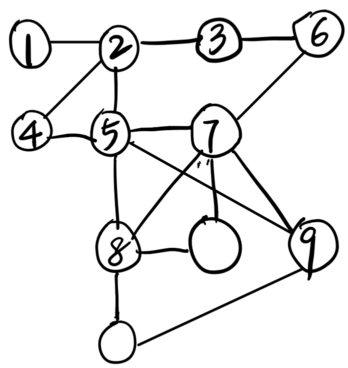
Labeled: S_0



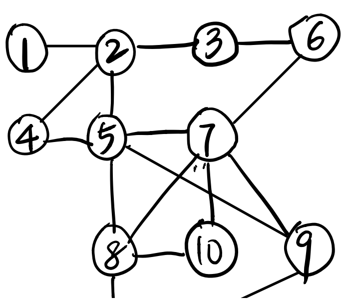
Labeled: S_0, S_1

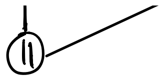


Labeled: S_0, S_1, S_2



Labeled: S_0, S_1, S_2, S_3



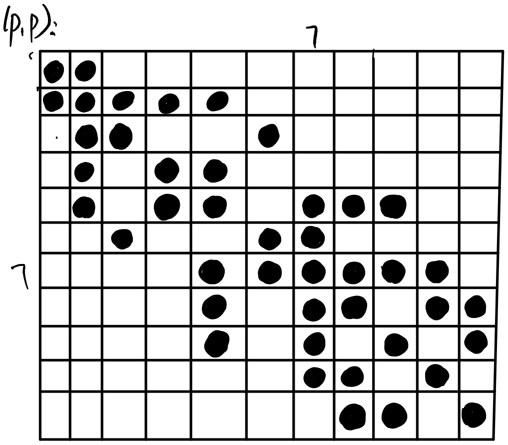


Labeled: S_0, S_1, S_2, S_3, S_4.

p:

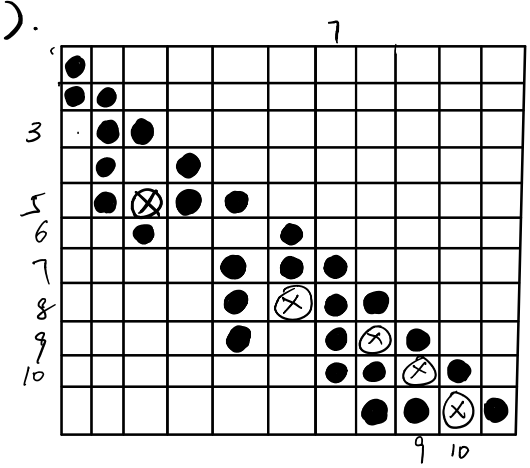
9	6	1	4	10	7	11	8	3	5	2
S_0	S_1	S_2			S_3				S_4	

A(p,p):

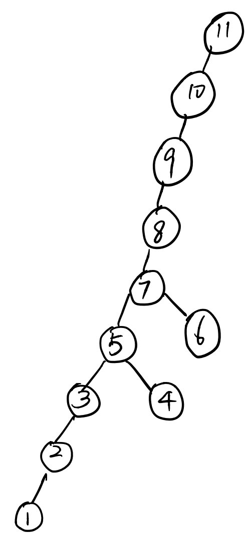


$$\text{profile}(A) = 11 + (0+1+1+2+3+3+2+3+4+3+3) = 36$$

(b).



A's Cholesky factor



A's elimination tree.