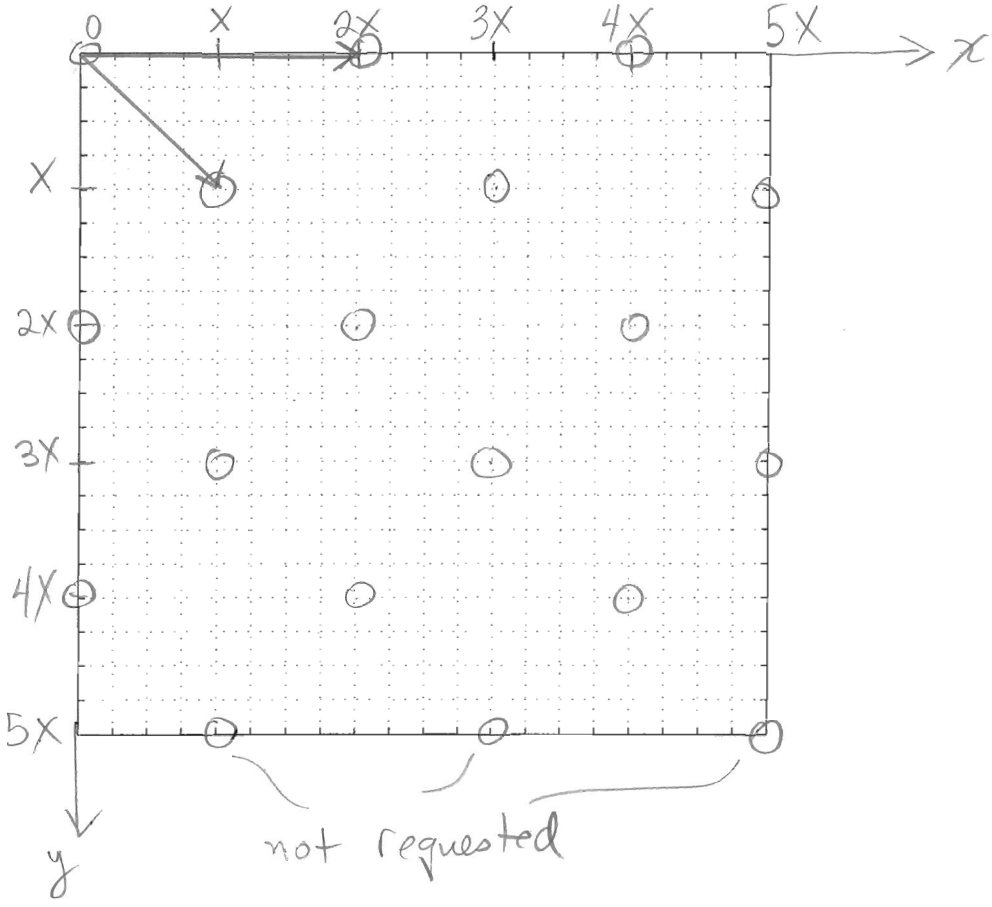
Name:
Student number:

CEG4311 Image Processing
Fall 2006
Quiz 1, October 2, 2006
Closed book – no notes or calculators

Question:

(a) The sampled green channel of a digital camera $f_G[x, y]$ is defined on the lattice Λ specified by the sampling matrix $\mathbf{V} = \begin{bmatrix} 2X & X \\ 0 & X \end{bmatrix}$. Assume that $X = \frac{1}{2400}$ ph. Sketch the points of the lattice for $0 \le x \le 5X$, $0 \le y \le 4X$.



use other side if needed

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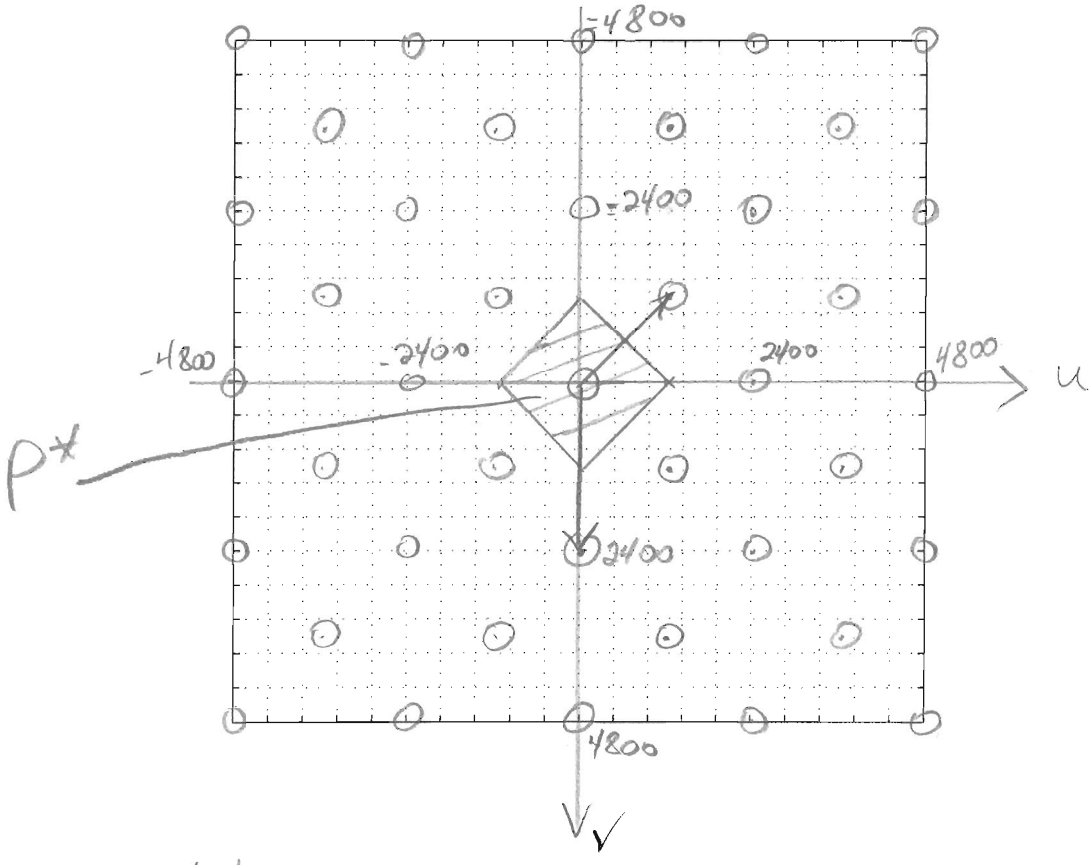
(b) Find a sampling matrix **U** for the reciprocal lattice Λ^* and carefully sketch to scale the points of Λ^* for $-\frac{2}{X} \le u \le \frac{2}{X}, -\frac{2}{X} \le v \le \frac{2}{X}$. Label your axes with numerical units in c/ph.

(c) On your sketch of (b), sketch to scale the Voronoi unit cell $\mathcal{P}^*$ of Λ^*. Explain what is the definition of $\mathcal{P}^*$ and how you have obtained it.



$\frac{2}{X} = 4800$ c/ph

$$\underline{U} = \underline{V}^{-T} = \begin{bmatrix} 2X & 0 \\ X & X \end{bmatrix}^{-1} = \begin{bmatrix} \frac{1}{2X} & 0 \\ -\frac{1}{2X} & \frac{1}{X} \end{bmatrix} = \begin{bmatrix} 1200 & 0 \\ -1200 & 2400 \end{bmatrix} \text{ c/ph}$$

(c) P^* is the set of all points closer to (0,0) than to any other lattice point.

It is obtained by drawing a perpendicular bisector of the lines between (0,0) and its nearest neighbors

use other side if needed