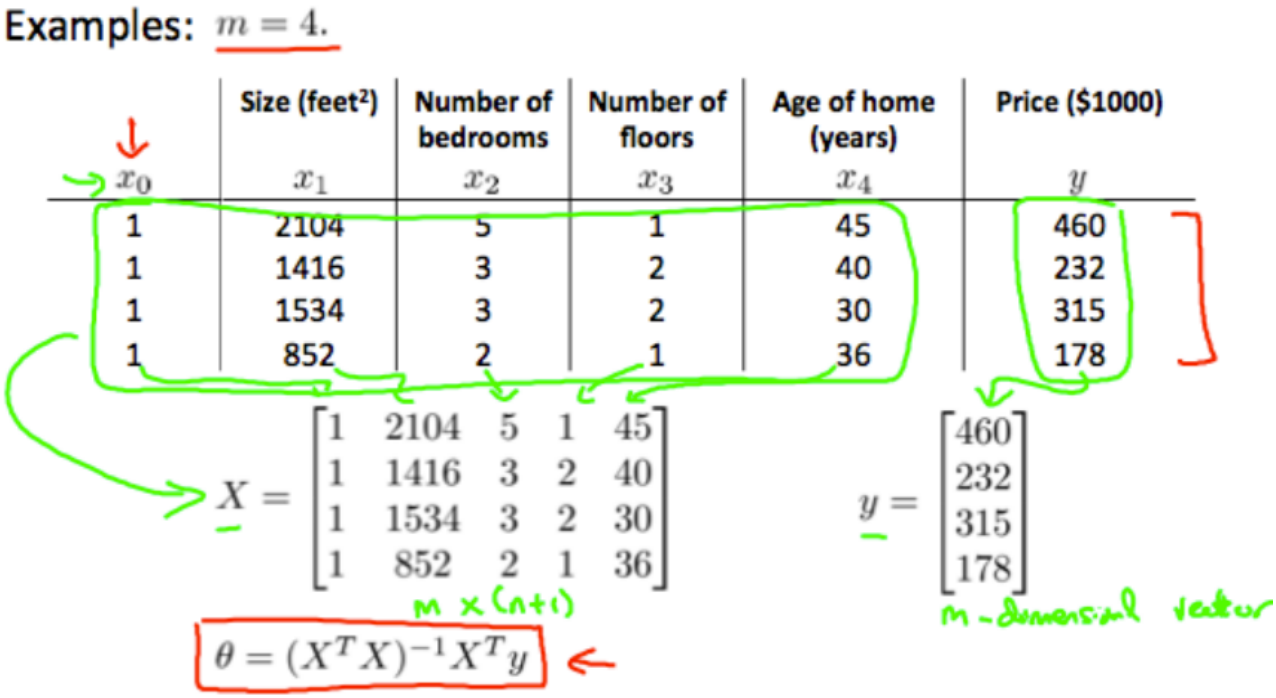
# Week 2.2 Computing Parameters Analytically

## Normal Equation

- Normal equation: Method to solve for $\theta$ analytically
- $\theta = (X^T X)^{-1} X^T y$
  详解正规方程（Normal Equation

```
pinv (X'*X)*X'*y
```

- X: design matrix




- Gradient Descent vs Normal Equation:

| Gradient Descent | Normal Equation |
| --- | --- |
| Need to choose alpha | No need to choose alpha |
| Needs many iterations | No need to iterate |
| O $(kn^2)$ | O $(n^3)$, need to calculate inverse of $X^T X$ |
| Works well when n is large | Slow if n is very large |

## Normal Equation Noninvertibility

- What if $X^T X$ is non-invertible? (rarely)
- pinv: compute inverse even when invertible
- Causes:

- Redundant features (linearly dependent)
- Too many feastures (e.g. $m \leq n$)
    - delete or use regularization