Poisson distribution into exponential factor.

Poisson distribution: $f(k;\lambda) = Pr(X=k) = \frac{\lambda^k e^{-\lambda}}{k!}$

Write into exponential family:

$$f(k;\lambda) = \frac{1}{k!} \cdot \exp \log_e(\lambda^k e^{-\lambda})$$
$$= \frac{1}{k!} \cdot (\exp \log_e \lambda^k) \cdot e^{-\lambda}$$
$$= \frac{1}{k!} e^{k \log_e \lambda - \lambda}$$

Let $T(y)=k$, $u = \log_e \lambda$, $a(u) = \lambda$, $b(u) = \frac{1}{k!}$

Then we have $P(y,u) = b(u) \exp(u\,T(y) - a(u))$

and $a(z) = \lambda = \exp(\log_e \lambda) = e^z$