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① Linearização de $f(x) = \cos(x)$

a) Sendo $\bar{x} = 0$, tem-se que

$$g(x) = f(\bar{x}) + \frac{\partial f}{\partial x}\Big|_{x=\bar{x}} \cdot (x - \bar{x})$$

$$g(x) = \cos(0) - \sin(0) \cdot (x - 0) = 1$$

b) Sendo $\bar{x} = \frac{\pi}{4}$

$$g(x) = \cos\left(\frac{\pi}{4}\right) - \sin\left(\frac{\pi}{4}\right)\left(x - \frac{\pi}{4}\right)$$

$$g(x) = \frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}\left(x - \frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}\left(\frac{4+\pi}{4} - x\right)$$

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② $$F(t) = m\dot{v} + mr\dot{\theta} - m\ddot{x}$$

Equilíbrio: $\bar{v}$, $\bar{r}$ e $\bar{\dot{r}} = 0$

→ Taylor:

$$f(x, \theta, r, \dot{r}, \dot{v}) \approx f(\bar{x}, \bar{\theta}, \bar{r}, \bar{\dot{r}}, \bar{v}) + \frac{\partial f}{\partial x}\Big|_{eq}(x - \bar{x}) + \ldots$$

para cada variável

$$\frac{\partial f}{\partial x} = -m\bar{\ddot{r}} = 0 \quad \Big| \quad \frac{\partial f}{\partial \theta} = m\bar{r} = 0 \quad \Big| \quad \frac{\partial f}{\partial r} = m\bar{\theta}$$

$$\frac{\partial f}{\partial \dot{r}} = -m\bar{\ddot{x}} \quad \Big| \quad \frac{\partial f}{\partial \dot{v}} = m \quad \Big| \quad f(eq) = 0$$

$$f(x, \theta, r, \dot{r}, \dot{v}) = m\bar{\theta}\cdot r - m\bar{\ddot{x}}\dot{r} + m\dot{v}$$

↳ $$m\dot{v} = F(t) + m\bar{\ddot{x}}\dot{r} - m\bar{\theta}r$$