Use the Fourier transform to find the solution of the heat equation (with $c = 1$)

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, \qquad \text{and} \qquad u(x,0) = e^{-x^2},$$

for a function $u(x,t)$ for $t \geq 0$ and $x \in \mathbb{R}$.