Problem Statement: Visualize the Rankine Cycle in MATLAB App

The **Rankine cycle** is a fundamental thermodynamic cycle used in power plants to convert heat into mechanical work, typically through steam turbines. It forms the basis for most power generation systems, including coal, nuclear, and some renewable energy plants.

Components of the Rankine Cycle

The cycle consists of four main processes:

1. **Pump (Isentropic Compression)**
    - The working fluid (typically water) is pressurised using a pump.
    - This increases its pressure and prepares it for heating in the boiler.
    - Since liquids are incompressible, the work input is minimal.
2. **Boiler (Isobaric Heat Addition)**
    - The high-pressure liquid enters a boiler, which absorbs heat at constant pressure and transforms into high-temperature, high-pressure steam.
    - The heat source can be combustion, nuclear reaction, or solar energy.
3. **Turbine (Isentropic Expansion)**
    - The high-pressure steam expands through a turbine, producing mechanical work that drives a generator to produce electricity.
    - The steam loses energy and pressure as it expands.
4. **Condenser (Isobaric Heat Rejection)**
    - The low-pressure steam exits the turbine and enters a condenser, where it releases heat to a cooling medium (air, water, or another refrigerant).
    - The steam condenses back into liquid water, completing the cycle.

Efficiency and Performance

- The **thermal efficiency** of the Rankine cycle is limited by the Carnot efficiency, as some heat is always rejected in the condenser.
- Superheating, reheating, and regenerative feedwater heating can be used to improve efficiency.

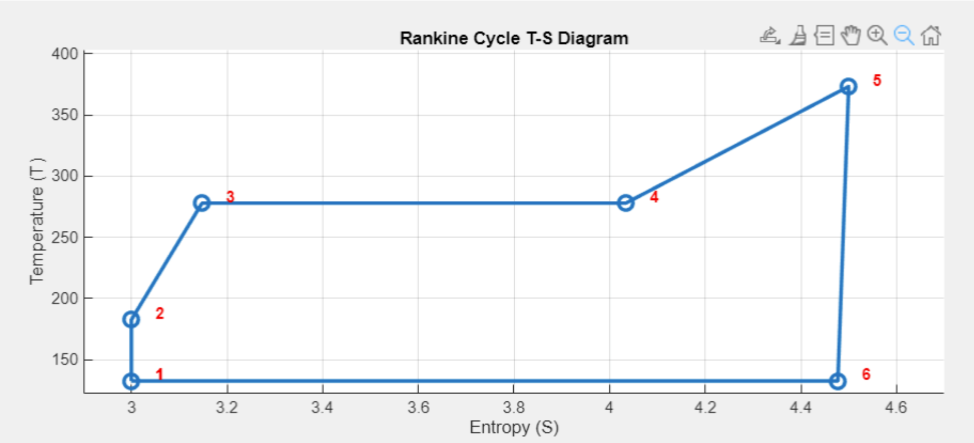
Applications

- Thermal power plants (coal, nuclear, biomass, geothermal)
- Combined cycle power plants (when integrated with gas turbines)
- Solar thermal power plants

The **Rankine Cycle** is the backbone of modern power plants, efficiently converting thermal energy into work.

Task: To develop a MATLAB App using App Designer that allows users to:

- **Input key cycle parameters** (Boiler & Condenser Pressure, Turbine Efficiency).
- **Compute thermodynamic properties** at each state point (entropy, temperature).
- **Plot an accurate Temperature-Entropy (T-S) Diagram** for the cycle.
- **Toggle between cycle variations** (Basic, Reheat, and Regenerative Rankine).



Thermodynamic Equations for the Rankine Cycle:

Saturation Temperature Approximation	$T_{sat} = 45.45 \cdot \ln(P) - 45.32$
Latent Heat Approximation	$H_{fg} = 2500 - 0.5 \cdot (T_{sat} - 100)$
Pump Work (1->2)	$h_2 = h_1 + (h_{2s} - h_1)/\eta_{pump}$ $h_{2s} = h_1 + (P_b - P_c) \cdot 0.0015$
Boiler Heat (2->5)	$h_5 = h_2 + h_{fg,\ boiler}$
Isentropic Expansion in Turbine (5->6)	$h_6 = h_5 - \eta_{turbine}(h_5 - h_1)$
Cycle Efficiency	$\eta_{cycle} = (W_{turbine} - W_{pump})/Q_{boiler} \times 100$ ○ $W_{turbine} = h5 - h6$ ○ $W_{pump} = h2 - h1$ ○ $Q_{boiler} = h5 - h2$