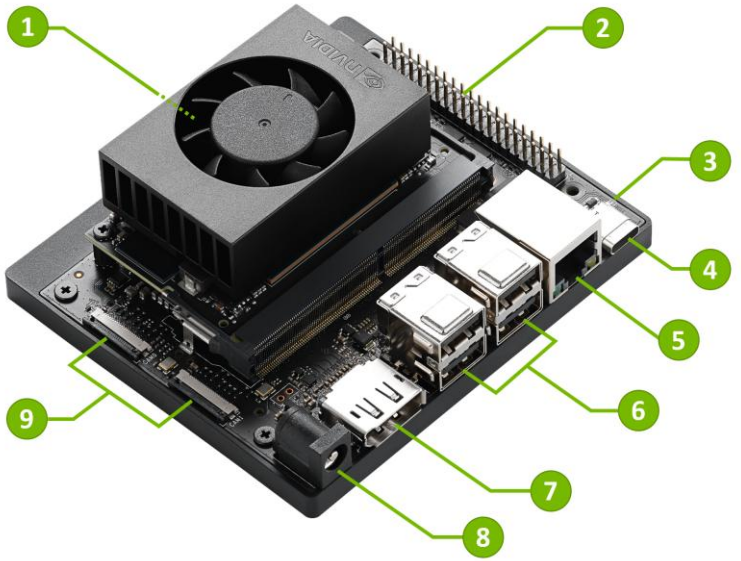



# *Jetson Orin Nano: Powering Edge AI with NVIDIA*

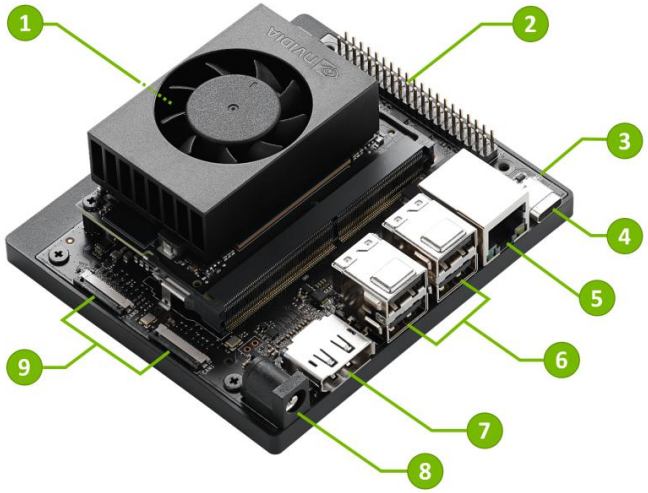
## A Practical Guide to Affordable AI at the Edge

*"AI at the edge. Power in your pocket. Jetson Nano."*

# What is Jetson Orin Nano?

- A compact, energy-efficient edge AI computer
- Successor to the Jetson Nano
- Based on **NVIDIA Orin SoC**
- Ideal for robotics, IoT, drones, and smart camera applications

| Feature | Jetson Orin Nano 4GB | Jetson Orin Nano 8GB |
|---|---|---|
| GPU | 512-core NVIDIA Ampere w/ 16 Tensor Cores | 1024-core NVIDIA Ampere w/ 32 Tensor Cores |
| CPU | 6-core Arm Cortex-A78AE @ 1.5 GHz | 6-core Arm Cortex-A78AE @ 1.5 GHz |
| Memory | 4 GB LPDDR5 | 8 GB LPDDR5 |
| Memory Bandwidth | 68 GB/s | 68 GB/s |
| AI Performance (INT8) | Up to 20 TOPS | Up to 40 TOPS |
| Storage (default) | microSD (external) | microSD or eMMC (depends on kit) |
| Display | 1x HDMI 2.0 | 1x HDMI 2.0 |
| Camera Interface | 2x MIPI CSI-2 (4 lanes each) | 2x MIPI CSI-2 (4 lanes each) |
| Connectivity | Gigabit Ethernet | Gigabit Ethernet |
| I/O Interfaces | 3x USB 3.2, GPIO, I2C, SPI, UART | 3x USB 3.2, GPIO, I2C, SPI, UART |
| PCIe Interface | 1x PCIe Gen3 x4 | 1x PCIe Gen3 x4 |
| Power Consumption | Configurable: 7W / 10W | Configurable: 7W / 15W |
| Operating Temp. Range | -25°C to 80°C (Tj max) | -25°C to 80°C (Tj max) |
| Form Factor | 70mm x 45mm SODIMM | 70mm x 45mm SODIMM |



# Key Features

| Feature | Details |
|---|---|
| GPU | 1024-core Ampere (w/ 32 Tensor Cores) |
| CPU | 6-core ARM Cortex-A78AE |
| AI Performance | Up to 40 TOPS |
| Memory | 4GB / 8GB LPDDR5 |
| Storage | microSD / eMMC |
| Power | 7W - 15W configurable |
| I/O | 2x CSI, GPIO, I2C, UART, SPI, etc. |

# Jetson Orin Nano Module Variants

| Module | Memory | AI Perf (TOPS) | Storage |
|---|---|---|---|
| Orin Nano 4GB | 4GB LPDDR5 | 20 TOPS | microSD |
| Orin Nano 8GB | 8GB LPDDR5 | 40 TOPS | microSD/eMMC |

# Jetson Orin Nano Developer Kit

- Includes Orin Nano module + reference carrier board
- Connect peripherals: HDMI, USB, Ethernet, CSI Cameras
- Power via USB-C or barrel jack
- Expandable via M.2 Key E slot (Wi-Fi, Bluetooth, SSD)

# JetPack SDK

- JetPack 6.0+ support
- Includes:
  - L4T (Linux for Tegra - Ubuntu-based OS)
  - CUDA 11/12
  - cuDNN, TensorRT
  - DeepStream SDK, OpenCV
  - NVIDIA Nsight Tools
- Install via SDK Manager (Ubuntu host)

# Common Use Cases

- AI-powered robotics
- Smart surveillance cameras
- Industrial inspection
- Voice recognition systems
- Edge inferencing for computer vision

# Jetson Orin Nano vs Jetson Nano

| Feature | Orin Nano | Jetson Nano |
|---|---|---|
| AI Perf | 20–40 TOPS | 0.5 TOPS |
| CPU | ARM Cortex-A78AE | ARM Cortex-A57 |
| GPU | Ampere | Maxwell |
| RAM | LPDDR5 | LPDDR4 |
| JetPack | 6.x | 4.x |

# Getting Started

1. Download JetPack Image from developer.nvidia.com
2. Flash image using **balenaEtcher**
3. Boot with display, keyboard, mouse
4. Setup Wi-Fi, SSH, VNC for headless operation
5. Test with detectnet.py from NVIDIA examples

# Tools & Frameworks Supported

- TensorFlow / PyTorch
- OpenCV
- ROS 2
- DeepStream SDK
- NVIDIA TAO Toolkit
- Docker + Containers

# Camera and Vision Capabilities

- Dual CSI camera support
- Real-time object detection with YOLOv5, SSD
- GStreamer pipeline for optimized video streaming

# Security Features

- Secure Boot
- Hardware cryptography engine
- TPM 2.0 support (depending on carrier)

# Live Demo Ideas

- Object detection with webcam
- People counting
- Facial recognition
- Real-time pose estimation

# Benchmarks

- ResNet-50 Inference: ~90 fps (INT8)
- YOLOv5s: ~70 fps (INT8)
- Latency comparison with Raspberry Pi 4

# Power Modes & Thermal Management

- 7W or 15W performance mode
- Use jetson_clocks for benchmarking
- Active cooling with fan sink or passive options

# Jetson Ecosystem

- NVIDIA Metropolis for smart cities
- Isaac Sim (robotics simulation)
- DeepStream SDK (smart video analytics)
- Jetson Community, Forums, GitHub

# Project Ideas

- Smart attendance system with facial recognition
- Object sorting robot using TensorFlow
- Wildlife monitoring camera trap
- AI chatbot on edge with voice interface

# Buy & Pricing

| Model | Approx. Price (USD) |
|---|---|
| Orin Nano 4GB Dev Kit | ~$199 |
| Orin Nano 8GB Dev Kit | ~$249 |

# Resources & Links

- Jetson Download Center
- Jetson Community Projects
- Jetson Forum
- Jetson Hacks GitHub