

Zen AI Model Family

Zen-Omni

Multimodal Text

Technical Whitepaper v1.0

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Abstract

We present **Zen-Omni**, a 30B parameter model optimized for multimodal text. Built upon zen-32B, this model achieves state-of-the-art performance while maintaining exceptional efficiency with only 30B active parameters. Supporting 256K thinking tokens for advanced reasoning, the model represents a significant advancement in democratizing AI through sustainable and efficient architectures.

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1 Introduction

The rapid advancement of artificial intelligence has created an unprecedented demand for models that balance capability with efficiency. **Zen-Omni** addresses this challenge by delivering enterprise-grade performance while maintaining a minimal computational footprint.

1.1 Key Innovations

- **Efficient Architecture:** 30B active parameters from 30B total
- **Specialized Training:** Optimized for multimodal text
- **Extended Context:** 128K context window
- **Thinking Mode:** 256K thinking tokens

2 Architecture

2.1 Model Design

Zen-Omni is based on the zen-32B architecture with several key modifications:

| Component | Specification |
|-------------------|---------------|
| Total Parameters | 30B |
| Active Parameters | 30B |
| Base Model | zen-32B |
| Context Length | 128K |
| Thinking Tokens | 256K |
| Architecture Type | Transformer |

Table 1: Zen-Omni Architecture Specifications

2.2 Technical Innovations

2.2.1 Mixture of Experts (MoE)

The model uses a dense architecture with all parameters active during inference, optimized for maximum performance per parameter.

2.2.2 Attention Mechanism

Extended attention mechanisms support up to 128K context length with efficient KV-cache management.

2.2.3 Thinking Mode

Advanced reasoning through extended thinking tokens (up to 256K), enabling:

- Step-by-step problem decomposition
- Self-correction and verification
- Complex multi-step reasoning
- Internal deliberation before response

3 Performance Benchmarks

3.1 Evaluation Results

| Benchmark | Score |
|-----------|-------|
| MMLU | 68.4% |
| HumanEval | 48.3% |
| GSM8K | 82.1% |
| HellaSwag | 78.7% |

Table 2: Language Understanding Benchmarks

3.2 Efficiency Metrics

| Metric | Value |
|-----------------------|---------------|
| Inference Speed | 85 tokens/sec |
| Memory Usage (INT4) | 15 GB |
| Energy Efficiency | 85% reduction |
| Latency (First Token) | 120 ms |

Table 3: Efficiency Metrics

4 Training Methodology

4.1 Dataset

The model was trained on a carefully curated dataset comprising:

- High-quality filtered web data (15TB)
- Domain-specific corpora for multimodal text
- Synthetic data generation for edge cases
- Human feedback through RLHF

4.2 Training Process

1. **Pretraining:** 5 trillion tokens over 45 days on 64x A100
2. **Supervised Fine-tuning:** Task-specific optimization
3. **RLHF:** Alignment with human preferences
4. **Constitutional AI:** Safety and helpfulness optimization

5 Use Cases and Applications

5.1 Primary Applications

Conversational AI and chatbots

Content generation and summarization

Code completion and review

Educational assistance

Research and analysis

5.2 Integration Examples

```
1 from transformers import AutoModelForCausalLM, AutoTokenizer
2
3 # Load model and tokenizer
4 model = AutoModelForCausalLM.from_pretrained("zenlm/zen-omni-30b-
    instruct")
5 tokenizer = AutoTokenizer.from_pretrained("zenlm/zen-omni-30b-instruct"
    )
6
7 # Generate response
8 inputs = tokenizer("Explain quantum computing", return_tensors="pt")
9 outputs = model.generate(**inputs, max_length=100)
10 response = tokenizer.decode(outputs[0])
```

Listing 1: Basic Usage Example

6 Environmental Impact

6.1 Sustainability Metrics

- **Carbon Footprint:** 0.25 kg CO₂e per million inferences
- **Energy Usage:** 5.5 kWh per day (1000 users)
- **Efficiency Gain:** 85% reduction vs comparable models

6.2 Green AI Commitment

Zen AI models are designed with sustainability as a core principle, achieving industry-leading efficiency through architectural innovations and optimization techniques.

7 Safety and Alignment

7.1 Safety Measures

- Constitutional AI training for harmlessness
- Comprehensive red-teaming and adversarial testing
- Built-in safety filters and guardrails
- Regular safety audits and updates

7.2 Ethical Considerations

The model has been developed with careful attention to:

- Bias mitigation through diverse training data
- Transparency in capabilities and limitations
- Privacy-preserving deployment options
- Responsible AI principles alignment

8 Deployment Options

8.1 Available Formats

- **SafeTensors**: Original precision weights
- **GGUF**: Quantized formats (Q4_K_M, Q5_K_M, Q8_0)
- **MLX**: Apple Silicon optimization (4-bit, 8-bit)
- **ONNX**: Cross-platform deployment (coming soon)

8.2 Hardware Requirements

| Precision | Memory | Recommended Hardware |
|-----------|--------|----------------------|
| FP16 | 60 GB | A100 40GB |
| INT8 | 30 GB | RTX 4090 |
| INT4 | 15 GB | M2 Max MacBook Pro |

Table 4: Hardware Requirements by Precision

9 Future Work

9.1 Planned Improvements

- Extended context windows (up to 1M tokens)
- Enhanced multimodal capabilities
- Improved efficiency through further optimization
- Expanded language support

9.2 Research Directions

- Advanced reasoning mechanisms
- Self-supervised learning improvements
- Zero-shot generalization enhancement
- Continual learning capabilities

10 Conclusion

Zen-Omni represents a significant advancement in AI democratization, delivering exceptional performance for multimodal text while maintaining unprecedented efficiency. Through innovative architecture design and careful optimization, the model achieves a balance between capability and sustainability that sets a new standard for responsible AI development.

Acknowledgments

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References

A Model Card

| Field | Value |
|---------------|---|
| Model Name | Zen-Omni |
| Version | 1.0.0 |
| Release Date | September 2025 |
| License | Apache 2.0 |
| Repository | huggingface.co/zenlm/zen-omni-30b-instruct |
| Documentation | github.com/zenlm/zen |
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Table 5: Model Card Information