

Towards Efficient Multimodal Unified Reasoning Model via Model Merging

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Appendix

A. The Use of Large Language Models (LLMs)

In this paper, large language model (LLM) [5] is only utilized to assist with the refinement of the English language. No LLMs are employed to generate new innovative ideas, and the research process is conducted by the researchers (humans).

B. Benchmarks

Our model is evaluated across four key categories, multimodal mathematical reasoning, multimodal structured data reasoning, OCR capabilities and general capabilities.

B.1. Mathematics Benchmarks

- **MathVista** [7] encompasses 6,141 questions spanning diverse domains including arithmetic, geometry, algebra, and statistics.
- **MathVision** [12] is a curated collection of 3,040 high-quality mathematical problems derived from real-world mathematics competitions.
- **MathVerse** [14] comprises 2,612 multimodal mathematical problems, accompanied by 15,672 manually annotated test samples. These samples are categorized into 3 primary question types and 12 subcategories, such as plane geometry, solid geometry, and functions.
- **WeMath** [9] comprises 6,500 visual mathematical problems, covering 67 hierarchical knowledge concepts and five levels of knowledge granularity. Complex problems are decomposed into a novel four-dimensional metric to hierarchically evaluate the inherent issues in the reasoning process of MLLMs.

B.2. Multimodal Structured Data Reasoning Benchmarks

- **ChartQA** [8] is a large-scale benchmark encompassing 9.6K human-authored questions alongside 23.1K questions generated from human-written chart summaries.
- **CharXiv** [13] involves 2,323 natural, challenging, and diverse charts sourced from scientific papers. It includes both descriptive questions that assess basic chart elements and reasoning questions that require synthesizing information from complex visual elements within the charts.

B.3. OCR Benchmarks

- **OCRbench** [6] comprises 1,000 question-answer pairs, with all answers undergoing manual verification and correction, designed to evaluate the OCR capabilities of MLLMs. It encompasses five components: text recognition, scene text-centered VQA, document-oriented VQA, key information extraction, and handwritten mathematical expression recognition.
- **OCR-Reasoning** [4] consists of 1,069 manually annotated examples, covering 6 core reasoning capabilities and 18 practical reasoning tasks within text-rich visual scenarios. It is specifically designed to systematically evaluate the performance of MLLMs in reasoning tasks involving text-rich images.

B.4. General Benchmarks

- **MME** [3] encompasses 14 subtasks, which are designed to measure the perceptual and cognitive capabilities of MLLMs.
- **MMStar** [2] consists of 1,500 challenging samples meticulously curated by humans, encompassing 6 core functionalities and 18 detailed tasks, aiming to evaluate the multi-modal capacities of MLLMs with a carefully balanced and purified selection of samples.

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C. Prompts

Prompt Template used for Length-Informed Relative Policy Optimization (LIPO).

You FIRST think about the reasoning process as an internal monologue and then provide the final answer. The reasoning process MUST BE enclosed within `</think>` `</think>` tags. The final answer MUST BE put in `\boxed{}`.

D. Inference Time

We compare the inference time across different benchmarks on eight A800 40G GPUs. As illustrated in Table 1, Tiny-R1V-3B (with LIPO) exhibits notable inference speed superiority over Qwen2.5-VL-3B-Instruct (with GRPO) across all evaluated benchmarks. Tiny-R1V employs fewer tokens during the inference process, resulting in significantly faster inference on each benchmark.

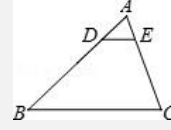
Table 1. Inference time on different benchmarks

Model	MathVista	ChartQA	OCRBench
Qwen2.5-VL-3B-Instruct(GRPO)	1788.4s	977.2s	788.4s
Tiny-R1V-3B(LIPO,Ours)	623.4s	455.4s	318.6s

E. Mathematics Reasoning Capabilities Case Studies

This section demonstrates the significant enhancement in reasoning capabilities of Tiny-R1V when addressing complex mathematical reasoning tasks. In these case studies, Tiny-R1V-3B accurately parses problems and derives correct answers, showcasing its robust proficiency in symbolic reasoning, geometric comprehension, and mathematical computation. Meanwhile, Tiny-R1V-3B achieves correct results using fewer tokens and simpler reasoning approaches, which demonstrate the superiority of its lightweight reasoning in handling complex reasoning tasks. Specifically, mathematical reasoning tasks require rigorous chain-of-mathematical-thought reasoning. Existing methods (such as Qwen2.5-VL-3B-Instruct [1], Qwen2.5VL-3B-GRPO [10], VLM-R1-Qwen2.5VL-3B-Math-0305 [11]) tend to employ multi-step complex computations and numerous equation transformation operations when tackling complex reasoning tasks. In contrast, our Tiny-R1V-3B can precisely leverage existing mathematical theorems to simplify the mathematical derivation process (see Case 1 and Case 2 for details). This simplified derivation process substantially reduces the token consumption during reasoning while ensuring the correctness of the reasoning process.

Mathematics Reasoning Capabilities Case1



Question: As shown in the figure, D and E are the points on the edges AB and AC of $\triangle ABC$, $DE \parallel BC$, if $AD : DB = 1.0 : 3.0$, $AE = 2.0$, then the length of AC is ().

Qwen2.5-VL-3B-Instruct Response: To solve for the length of AC , we start by analyzing the given information and the geometric relationships in the triangle.

1. **Identify the coordinates of points A , B , and C :**

- Let $A = (0, 4)$, $B = (0, 0)$, and $C = (4, 0)$.
- Since $AD : DB = 1 : 3$, point D divides AB in the ratio 1:3. Therefore, the coordinates of D are $(0, \frac{4 \cdot 1}{1+3}) = (0, 1)$.
- Since $DE \parallel BC$, point E divides AC in the same ratio as D divides AB , which is 1:3. Therefore, the coordinates of E are $(\frac{4 \cdot 1}{1+3}, 0) = (1, 0)$.

2. **Calculate the length of AC :**

- The length of AC is the distance from $A = (0, 4)$ to $C = (4, 0)$. Using the distance formula:

$$AC = \sqrt{(4 - 0)^2 + (0 - 4)^2} \quad (1)$$

$$= \sqrt{4^2 + (-4)^2} \quad (2)$$

$$= \sqrt{16 + 16} \quad (3)$$

$$= \sqrt{32} \quad (4)$$

$$= 4\sqrt{2} \quad (5)$$

Thus, the length of AC is $\boxed{4\sqrt{2}}$.

[Incorrect]

Qwen2.5VL-3B-GRPO Response: `<think>` Since $DE \parallel BC$, triangles ADE and ABC are similar by the AA similarity criterion. Therefore, the ratios of corresponding sides are equal. Given $AD : DB = 1 : 3$, we can infer that $AD = \frac{1}{4}AB$ and $DB = \frac{3}{4}AB$. Since $AB = AD + DB = 4$ cm, we have $AD = 1$ cm and $DB = 3$ cm. Because $DE \parallel BC$, the ratio $AD : AB = AE : AC$. Given $AE = 2$ cm, we can set up the proportion:

$$\frac{AD}{AB} = \frac{AE}{AC} \implies \frac{1}{4} = \frac{2}{AC} \implies AC = 8 \text{ cm}$$

Thus, the length of AC is 8 cm. \square [Correct]

VLM-R1-Qwen2.5VL-3B-Math-0305:

1. Given that $AD : DB = 1 : 3$, we can determine the length of AD and DB . 2. Since $AD + DB = AB$ and $AB = 4$, we can write:

$$AD + DB = 4$$

3. Given $AD : DB = 1 : 3$, we can express AD and DB in terms of a common variable x :

$$AD = x \quad \text{and} \quad DB = 3x$$

4. Substituting these into the equation $AD + DB = 4$:

$$x + 3x = 4$$

5. Solving for x :

$$4x = 4 \implies x = 1$$

6. Therefore, $AD = 1$ and $DB = 3$.

Since $DE \parallel BC$, DE is parallel to BC and DE is half the length of BC because $AD : DB = 1 : 3$.

7. Given $AE = 2$, we can determine the length of AC :

$$AC = AE + EC$$

8. Since $DE \parallel BC$, $EC = DB = 3$. 9. Therefore:

$$AC = AE + EC = 2 + 3 = 5$$

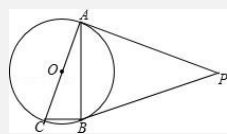
\square [Incorrect]

Tiny-R1V-3B Response (Ours):

Given that $DE \parallel BC$, it implies that $\triangle ADE \sim \triangle ABC$ by the Basic Proportionality Theorem (or Thales' theorem). Therefore, the ratios of corresponding sides are equal. Since $AD : DB = 1 : 3$, $AD : AB = 1 : 4$. Thus, $AE : AC = 1 : 4$. Given $AE = 2$, we can find AC as $AC = 4 \times AE = 4 \times 2 = 8$.

Answer: \square [Correct]

Mathematics Reasoning Capabilities Case2



Question: As shown in the figure, PA and PB are tangents of $\odot O$, with tangent points A and B , AC is the diameter of $\odot O$, given that $\angle P = 50.0$, then the size of $\angle ACB$ is ().

Qwen2.5-VL-3B-Instruct Response: To solve for the size of $\angle ACB$, we start by analyzing the given information and the geometric properties of the circle and the tangents.

1. Identify the properties of the tangents and the circle:

- PA and PB are tangents to the circle $\odot O$ at points A and B respectively.
- AC is the diameter of the circle.
- $\angle P = 50^\circ$.

2. Use the property of tangents:

- The tangents drawn from an external point to a circle are equal in length. Therefore, $PA = PB$.
- The line segment OA is perpendicular to the tangent PA at the point of tangency A , so $\angle OAP = 90^\circ$.
- Similarly, $\angle OBP = 90^\circ$.

3. Determine the angles in $\triangle OAP$ and $\triangle OBP$:

- Since $\angle OAP = 90^\circ$ and $\angle OBP = 90^\circ$, the sum of the angles in $\triangle OAP$ and $\triangle OBP$ is 180° .
- Therefore, $\angle AOP = 180^\circ - \angle P = 180^\circ - 50^\circ = 130^\circ$.

4. Use the fact that AC is the diameter:

- Since AC is the diameter, $\angle ABC = 90^\circ$ (angle in a semicircle).
- Now, consider $\triangle OAC$. Since $OA = OB$ (both are radii of the circle), $\triangle OAC$ is isosceles with $\angle OAC = \angle OCA$.
- The sum of the angles in $\triangle OAC$ is 180° . Since $\angle OAC = \angle OCA$ and $\angle AOP = 90^\circ$, we have $\angle OAC = \angle OCA = \frac{180^\circ - 90^\circ}{2} = 45^\circ$.
- Therefore, $\angle ACB = \angle OAC + \angle OCA = 45^\circ + 45^\circ = 90^\circ - \frac{\angle P}{2} = 90^\circ - 25^\circ = 65^\circ$.

Thus, the size of $\angle ACB$ is \square [Correct]

Qwen2.5VL-3B-GRPO Response:

Since PA and PB are tangents to $\odot O$ from point P , $PA = PB$. Therefore, $\triangle PAB$ is isosceles with $\angle P = 50^\circ$. The sum of the angles in a triangle is 180° , so we have:

$$\angle PAB = \angle PBA = \frac{180^\circ - 50^\circ}{2} = 65^\circ.$$

Since AC is a diameter, $\angle ABC = 90^\circ$ (angle in a semicircle). Now, $\angle ACB$ can be found by noting that $\angle ACB = 180^\circ - \angle CAB - \angle ABC$. Since

$\angle CAB = \angle PAB = 65^\circ$, we have:

$$\angle ACB = 180^\circ - 65^\circ - 90^\circ = 25^\circ.$$

$\langle \text{think} \rangle$ $\boxed{25^\circ}$ **[Incorrect]**

VLM-R1-Qwen2.5VL-3B-Math-0305:

$\langle \text{think} \rangle$ To solve for the size of $\angle ACB$, we start by noting that PA and PB are tangents to the circle $\odot O$ at points A and B respectively. This means that OA and OB are perpendicular to PA and PB respectively. Therefore, $\angle OAP = 90^\circ$ and $\angle OBP = 90^\circ$.

Since AC is the diameter of the circle, $\angle ABC = 90^\circ$ because any angle inscribed in a semicircle is a right angle. Now, we need to find $\angle ACB$. We know that $\angle P = 50^\circ$, and since PA and PB are tangents, $\angle OAP = 90^\circ$ and $\angle OBP = 90^\circ$. The angle $\angle APB$ is the external angle to $\triangle OAP$ and $\triangle OBP$, and it is equal to the sum of the opposite internal angles, which are $\angle OAP$ and $\angle OBP$. Therefore, $\angle APB = 180^\circ - \angle OAP - \angle OBP = 180^\circ - 90^\circ - 90^\circ = 180^\circ - 180^\circ + 50^\circ = 50^\circ$.

Now, we can use the fact that the sum of the angles in $\triangle APB$ is 180° . So, $\angle BAP + \angle ABP + \angle APB = 180^\circ$. Since $\angle BAP = \angle OAP = 90^\circ$ and $\angle ABP = \angle OBP = 90^\circ$, we have $\angle BAP + \angle ABP = 180^\circ - \angle APB = 180^\circ - 50^\circ = 130^\circ$. Therefore, $\angle ACB = 180^\circ - \angle ABC - \angle BAC = 180^\circ - 90^\circ - 40^\circ = 50^\circ$.

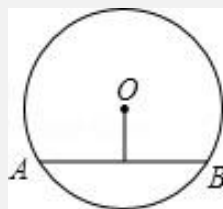
Thus, the size of $\angle ACB$ is $\boxed{40^\circ}$. $\langle \text{think} \rangle$
 $\langle \text{answer} \rangle$ 40° $\langle \text{answer} \rangle$ **[Incorrect]**

Tiny-R1V-3B Response (Ours): $\langle \text{think} \rangle$

Since PA and PB are tangents, $\angle OAP$ and $\angle OBP$ are both 90° . Thus, $\angle AOB$ is supplementary to $\angle P$, making it 130° . Since AC is the diameter, $\angle ACB$ is an inscribed angle subtending the same arc, thus $\angle ACB$ is half of the central angle, which is 65° . Therefore, $\angle ACB$ is half of the remaining angle at the circumference. $\langle \text{think} \rangle$

Answer: $\boxed{65^\circ}$ **[Correct]**

Mathematics Reasoning Capabilities Case3



Question: As shown in the figure, in $\odot O$ with a radius of 5.0, the length of the chord AB is 8.0, then the distance from the center O to the chord AB is ().

Qwen2.5-VL-3B-Instruct Response: To find the distance from the center O to the chord AB in the circle, we can use the Pythagorean theorem. Here's the step-by-step solution:

1. Identify the given information:

- The radius of the circle $OA = OB = 5.0$.
- The length of the chord $AB = 8.0$.

2. Draw the perpendicular from the center O to the chord AB :

- Let the perpendicular from O to AB intersect AB at point M . Since OM is perpendicular to AB , M is the midpoint of AB .
- Therefore, $AM = MB = \frac{AB}{2} = \frac{8.0}{2} = 4.0$.

3. Form a right triangle OAM :

- In the right triangle OAM , OA is the hypotenuse, AM is one leg, and OM is the other leg.
- We know $OA = 5.0$ and $AM = 4.0$.
- We need to find the length of OM .

4. Apply the Pythagorean theorem:

$$OA^2 = OM^2 + AM^2$$

Substituting the known values:

$$5.0^2 = OM^2 + 4.0^2$$

$$25.0 = OM^2 + 16.0$$

$$OM^2 = 25.0 - 16.0$$

$$OM^2 = 9.0$$

$$OM = \sqrt{9.0} = 3.0$$

Therefore, the distance from the center O to the chord AB is $\boxed{3.0}$. **[Correct]**

Qwen2.5VL-3B-GRPO Response: $\langle \text{think} \rangle$ To find the distance from the center O to the chord AB , we can use the geometric properties of the circle. Specifically, we can use the fact that the perpendicular from the center of the circle to a chord bisects

the chord. Let's denote the distance from the center O to the chord AB as d . The perpendicular from O to AB will split AB into two equal segments, each of length 4 (since $AB = 8$).

We can now consider the right triangle OAC where OC is the distance from the center to the chord, OA is the radius of the circle, and AC is half the length of the chord AB . By the Pythagorean theorem, we have:

$$OA^2 = OC^2 + AC^2$$

Substituting the known values $OA = 5$ and $AC = 4$, we get:

$$5^2 = d^2 + 4^2$$

$$25 = d^2 + 16$$

$$d^2 = 25 - 16$$

$$d^2 = 9$$

$$d = \sqrt{9} = 3$$

So, the distance from the center O to the chord AB is 3. **[Correct]**

VLM-R1-Qwen2.5VL-3B-Math-0305:

<think> To find the distance from the center O to the chord AB , we can use the Pythagorean theorem. Here's the step-by-step reasoning:

1. Identify the given information:

- The radius of the circle $\odot O$ is 5.0.
- The length of the chord AB is 8.0.

2. Draw the perpendicular from the center O to the chord AB :

- Let the perpendicular from O to AB intersect AB at point M . Since OM is perpendicular to AB , M is the midpoint of AB .
- Therefore, $AM = MB = \frac{AB}{2} = \frac{8.0}{2} = 4.0$.

3. Form a right triangle OMA :

- In the right triangle OMA , OA is the radius of the circle, so $OA = 5.0$.
- AM is half the length of the chord AB , so $AM = 4.0$.
- OM is the distance from the center O to the chord AB , which we need to find.

4. Apply the Pythagorean theorem:

- The Pythagorean theorem states that in a right triangle, the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.
- In triangle OMA , OA is the hypotenuse, OM is one leg, and AM is the other leg.
- Therefore, $OA^2 = OM^2 + AM^2$.

- Substituting the known values, we get $5.0^2 = OM^2 + 4.0^2$.
- Simplifying, we get $25.0 = OM^2 + 16.0$.
- Solving for OM^2 , we get $OM^2 = 25.0 - 16.0 = 9.0$.
- Taking the square root of both sides, we get $OM = \sqrt{9.0} = 3.0$.

Therefore, the distance from the center O to the chord AB is 3.0.

</think> **[Correct]**

Tiny-R1V-3B Response (Ours):

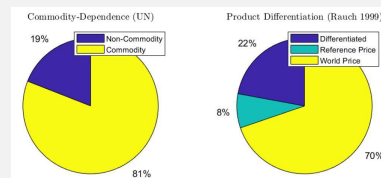
<think> Given a circle with radius 5 and chord $AB = 8$, we can use the right triangle formed by the radius, the perpendicular from the center to the chord, and half of the chord. The perpendicular bisects AB into two segments of 4 each, so we use the Pythagorean theorem: $5^2 = 4^2 + d^2$, where d is the distance from O to AB . Thus, $25 = 16 + d^2$, so $d^2 = 9$ and $d = 3$. *</think>*

Answer: **[Correct]**

F. Table, Chart and Document Reasoning Capabilities Case Studies

This section demonstrates a significant improvement in the reasoning capabilities of Tiny-R1V when tackling table, chart, and document reasoning tasks. In these case studies, Tiny-R1V-3B can accurately parse questions and derive correct answers. Structured data reasoning tasks require both perception and reasoning capabilities; however, the perception process may consume a large number of redundant tokens. As the cases below, Tiny-R1V-3B has reduced such redundant perception processes, thereby achieving a more efficient perception process and a more accurate reasoning process.

Table, Chart and Document Reasoning Capabilities Case 1



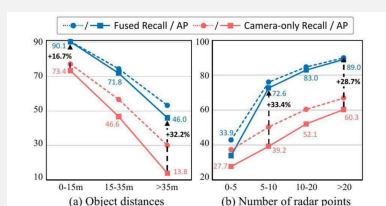
Question: What is the name of the chart with the highest percentage for its largest category?

Qwen2.5-VL-3B-Instruct Response: The chart with the highest percentage for its largest category is the one on the right, which is labeled "Product Differentiation (Rauch 1999)". **[Incorrect]**

Qwen2.5VL-3B-GRPO Response: `<think>` Looking at the two pie charts, the left one shows "Commodity-Dependence (UN)" with 81% for Commodity and 19% for Non-Commodity. The right one shows "Product Differentiation (Rauch 1999)" with 70% for World Price, 22% for Differentiated, and 8% for Reference Price. The chart with the highest percentage for its largest category is the left one, as it has 81% for Commodity. `</think>`
 [Correct]

Tiny-R1V-3B Response (Ours):`<think>` The chart on the left shows a clear majority of the category labeled "Commodity" at 81%, indicating it's the largest segment. The right chart shows a significant portion for "World Price" at 70%, but the left chart's largest category is more dominant.`</think>`
 Answer:
[Correct]

Table, Chart and Document Reasoning Capabilities Case2



Question: Does increase the number of radar points close the gap between Fused recall and Camera-only recall?

Qwen2.5-VL-3B-Instruct Response: Yes, increasing the number of radar points generally closes the gap between Fused Recall and Camera-only Recall. This can be seen in both graphs:

- Graph (a): Object Distances**
 - The Fused Recall/AP line (solid blue) shows a significant improvement as the object distance increases.
 - The Camera-only Recall/AP line (dashed red)

shows a corresponding decrease in performance.

- As the object distance increases, the gap between the two lines narrows, indicating that the fused approach performs better.

2. Graph (b): Number of Radar Points

- The Fused Recall/AP line (solid blue) shows a significant improvement as the number of radar points increases.
- The Camera-only Recall/AP line (dashed red) shows a corresponding decrease in performance.
- As the number of radar points increases, the gap between the two lines narrows, indicating that the fused approach performs better.

In both cases, the fused approach (solid lines) consistently outperforms the camera-only approach (dashed lines) as the number of radar points or object distances increase. **[Correct]**

Qwen2.5VL-3B-GRPO Response: `<think>` The graph shows two lines: one for "Fused Recall / AP" (solid blue line) and one for "Camera-only Recall / AP" (dotted red line). The solid blue line starts at 90.1% for 0-15m and decreases to 46.0% for >35m. The dotted red line starts at 73.4% for 0-15m and decreases to 13.8% for >35m. The gap between the two lines is significant, especially at shorter distances. As the number of radar points increases (from 0-5 to >20), the solid blue line (Fused Recall) increases from 33.9% to 89.0%, while the dotted red line (Camera-only Recall) increases from 27.7% to 60.3%. This indicates that increasing the number of radar points does indeed help close the gap between the Fused Recall and Camera-only Recall. `</think>` **[Correct]**

Tiny-R1V-3B Response (Ours): `<think>` The graphs show that as the number of radar points increases, the Fused Recall/AP line approaches the Camera-only Recall/AP line, indicating a closing gap. This suggests that more radar data points improve the recall and AP metrics, aligning the performance closer to the camera-only results. The percentage increases also support this, showing improvements as the number of points grows.`</think>`

Answer: **[Correct]**

Table, Chart and Document Reasoning Capabilities Case3

ITEM 6. SELECTED FINANCIAL DATA.

The following selected financial data has been derived from our audited financial statements. This data should be read in conjunction with Item 7—"Management's Discussion and Analysis of Financial Condition and Results of Operations" and our financial statements and related notes thereto included elsewhere in this Form 10-K. Our historical results are not necessarily indicative of operating results to be expected in the future.

	Year Ended September 30,			
	2018	2018	2017	2016
Income Statement Data				
Revenue	\$ 84,590	\$ 63,559	\$ 45,390	\$ 34,701
Operating income (loss)	\$ (4,590)	\$ (7,806)	\$ 2,769	\$ 1,824
Net income (loss)	\$ (724)	\$ (11,807)	\$ 14,092	\$ 1,059
Net income (loss) per share—basic	\$ (0.02)	\$ (0.33)	\$ 0.43	\$ 0.06
Net income (loss) per share—diluted	\$ (0.02)	\$ (0.33)	\$ 0.40	\$ 0.06
Balance Sheet Data				
Working capital	\$ 34,082	\$ 17,221	\$ 41,342	\$ 31,909
Total assets	\$ 135,897	\$ 127,150	\$ 71,719	\$ 48,385
Other borrowings	\$ 556	\$ 810	\$ —	\$ —
Stockholders' equity	\$ 107,333	\$ 95,294	\$ 61,408	\$ 39,885

Question: What is the percentage change in working capital from 2018 to 2019?

Qwen2.5-VL-3B-Instruct Response: To calculate the percentage change in working capital from 2018 to 2019, we use the formula:

$$\text{Percent Change} = \left(\frac{\text{New Value} - \text{Old Value}}{\text{Old Value}} \right) \times 100$$

Given:

- Working capital in 2019: \$34,082
- Working capital in 2018: \$17,221

Plugging in the values:

$$\text{Percentage Change} = \left(\frac{34,082 - 17,221}{17,221} \right) \times 100$$

$$\text{Percentage Change} = \left(\frac{16,861}{17,221} \right) \times 100$$

$$\text{Percentage Change} \approx 97.48\%$$

So, the percentage change in working capital from 2018 to 2019 is approximately 97.48%.

[Incorrect]

Qwen2.5-VL-3B-GRPO Response: <think> To calculate the percentage change in working capital from 2018 to 2019: Percentage change = (New value - Original value) / Original value * 100

Working capital in 2018 = \$17,221

Working capital in 2019 = \$34,082

Percentage change = (\$34,082 - \$17,221) / \$17,221 * 100

Percentage change = \$16,861 / \$17,221 * 100

Percentage change ≈ 97.28%

</think> **97.28%**

[Incorrect]

Tiny-R1V-3B Response (Ours): <think>

The working capital in 2018 was \$17,221 thousand and in 2019 it was \$34,082 thousand. The change is calculated as (34,082 - 17,221) / 17,221 * 100 = 97.9%. This indicates an increase of approximately 97.9% in working capital from 2018 to 2019.</think>

Answer: **97.9%**

[Correct]

Table, Chart and Document Reasoning Capabilities Case4

2019 Annual Report
Management's Discussion and Analysis of Financial Condition and Results of Operations continued

Consolidated Revenues

Years Ended December 31,	2019		2018		2019 vs. 2018	
	(dollars in millions)	Increase/(Decrease)	(dollars in millions)	Increase/(Decrease)	(dollars in millions)	% Change
Consumer	\$ 91,056	\$ 89,762	\$ 1,294	1.4%		
Business	31,443	31,534	(91)	(0.3)		
Corporate and other	9,812	9,936	(124)	(1.2)		
Eliminations	(443)	(369)	(74)	20.1		
Consolidated Revenues	\$ 131,868	\$ 130,962	\$ 906	0.8		

Consolidated revenues increased \$10 billion, or 0.8%, during 2019 compared to 2018, primarily due to an increase in revenues at our Consumer segment, partially offset by decreases in revenues at our Business segment and Corporate and other.

Revenues for our segments are discussed separately below under the heading "Segment Results of Operations."

Corporate and other revenues decreased \$124 million, or 1.2%, during 2019 compared to 2018, primarily due to a decrease of \$232 million in revenues within Verizon Media.

Consolidated Operating Expenses

Years Ended December 31,	2019		2018		2019 vs. 2018	
	(dollars in millions)	Increase/(Decrease)	(dollars in millions)	Increase/(Decrease)	(dollars in millions)	% Change
Cost of services	\$ 31,772	\$ 32,185	\$ (413)	(1.3)%		
Cost of wireless equipment	22,954	23,323	(369)	(1.6)		
Selling, general and administrative expense	29,896	31,083	(1,187)	(3.8)		
Depreciation and amortization expense	16,682	17,403	(721)	(4.1)		
Media goodwill impairment	186	4,591	(4,405)	(95.9)		
Consolidated Operating Expenses	\$ 101,490	\$ 108,585	\$ (7,095)	(6.5)		

Operating expenses for our segments are discussed separately below under the heading "Segment Results of Operations."

Cost of Services

Cost of services includes the following costs directly attributable to a service: salaries and wages, benefits, materials and supplies, contract costs, contracted services, network access and transport costs, customer provisioning costs, computer systems support, and costs to support our outsourcing contracts and technical facilities. Aggregate customer care costs, which include billing and service provisioning, are allocated between Cost of services and Selling, general and administrative expense.

Cost of services decreased \$413 million, or 1.3%, during 2019 compared to 2018, primarily due to decreases in network access costs, a product realignment charge in 2018 (see "Special Items"), decreases in employee-related costs resulting from the Voluntary Separation Program and decreases in digital content costs. These decreases were partially offset by increases in rent expense as a result of adding capacity to the networks to support demand and the adoption of the new lease accounting standard in 2019, regulatory fees, and costs related to the device protection package offered to our wireless retail postpaid customers.

Cost of Wireless Equipment

Cost of wireless equipment decreased \$369 million, or 1.6%, during 2019 compared to 2018, primarily as a result of declines in the number of wireless devices sold as a result of an elongation of the handset upgrade cycle, partially offset by a shift to higher priced devices in the mix of wireless devices sold.

Selling, General and Administrative Expense

Selling, general and administrative expense includes salaries and wages and benefits not directly attributable to a service or product, bad debt charges, taxes other than income taxes, advertising and sales commission costs, call center and information technology costs, regulatory fees, professional service fees, and rent and utilities for administrative space. Also included is a portion of the aggregate customer care costs as discussed above in "Cost of Services."

Selling, general and administrative expense decreased \$1.2 billion, or 3.8%, during 2019 compared to 2018, primarily due to decreases in employee-related costs primarily due to the Voluntary Separation Program, a decrease in severance, pension and benefits charges (see "Special Items"), the acquisition and integration related charges in 2018 primarily related to the acquisition of

Question: What was the average corporate segment revenue and other segment revenue for 2018 and 2019?

Qwen2.5-VL-3B-Instruct Response: To calculate the average corporate segment revenue and other segment revenue for 2018 and 2019, we need to follow these steps:

1. Identify the revenue for the corporate and other segment for both years.
2. Calculate the average of these two values.

From the table:

- Corporate and other revenue for 2019: \$9,812 million
- Corporate and other revenue for 2018: \$9,936 million

million
Now, we calculate the average:

$$\text{Average} = \frac{2019 \text{ Revenue} + 2018 \text{ Revenue}}{2}$$

$$\text{Average} = \frac{9,812 + 9,936}{2}$$

$$\text{Average} = \frac{19,748}{2}$$

$$\text{Average} = 9,874 \text{ million dollars}$$

So, the average corporate segment revenue and other segment revenue for 2018 and 2019 is \$9,874 million. **[Correct]**

Qwen2.5VL-3B-GRPO Response: <think> To find the average corporate and other segment revenue for 2018 and 2019, we need to add the revenues for both years and divide by 2. For 2019, the corporate and other segment revenue is \$9,812 million. For 2018, the corporate and other segment revenue is \$9,936 million. Average = (9,812 + 9,936) / 2 Average = 19,748 / 2 Average = \$9,874 million Therefore, the average corporate and other segment revenue for 2018 and 2019 is \$9,874 million. </think> **[Correct]**

Tiny-R1V-3B Response (Ours): <think> To find the average, I'll add the revenues for both segments in 2018 and 2019, then divide by 2. For Corporate and other, it's (9,936 + 9,812) / 2 = 9874. </think> **[Correct]**

G. OCR Capabilities Case Studies

This section demonstrates the capability of Tiny-R1V in OCR tasks. In these case studies, Tiny-R1V-3B can accurately recognize image content and derive correct answers, and exhibits accurate performance in tasks such as formula recognition, image-based question answering, and character parsing.

OCR Capabilities Case1

$$\begin{aligned} \arg \min_{\mathbf{u}} \quad & \frac{1}{2} \|\mathbf{u}\|^2 + C \sum_{\forall i, j, \mathbf{v}_{t_i} > \mathbf{v}_{t_j}} \epsilon_{ij} \\ \text{s.t.} \quad & \mathbf{u}^T \cdot (\mathbf{v}_{t_i} - \mathbf{v}_{t_j}) \geq 1 - \epsilon_{ij} \\ & \epsilon_{ij} \geq 0. \end{aligned}$$

Question: Please write out the expression of the formula in the image using LaTeX format.

Tiny-R1V-3B Response: <think>

$$\arg \min_{\mathbf{u}} \frac{1}{2} \|\mathbf{u}\|^2 + C \sum_{\forall i, j, \mathbf{v}_{t_i} > \mathbf{v}_{t_j}} \epsilon_{ij} \quad (6)$$

$$\text{s.t.} \quad \mathbf{u}^T \cdot (\mathbf{v}_{t_i} - \mathbf{v}_{t_j}) \geq 1 - \epsilon_{ij} \quad (7)$$

$$\epsilon_{ij} \geq 0. \quad (8)$$

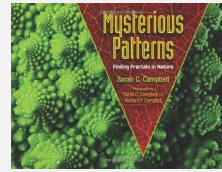
</think>

Answer:

$$\begin{aligned} \arg \min_{\mathbf{u}} \quad & \frac{1}{2} \|\mathbf{u}\|^2 + C \sum_{\forall i, j, \mathbf{v}_{t_i} > \mathbf{v}_{t_j}} \epsilon_{ij} \\ \text{s.t.} \quad & \mathbf{u}^T \cdot (\mathbf{v}_{t_i} - \mathbf{v}_{t_j}) \geq 1 - \epsilon_{ij} \\ & \epsilon_{ij} \geq 0. \end{aligned}$$

[Correct]

OCR Capabilities Case2

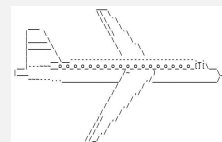


Question: Please write out the expression of the formula in the image using LaTeX format.

Tiny-R1V-3B Response: <think> Sarah C. Campbell </think>

Answer: **[Correct]**

OCR Capabilities Case3



Question: Which of the following options best matches the image? Here's some options: submarine, airplane, ship, chopper.

Tiny-R1V-3B Response: <think> The image depicts a shape that resembles an airplane with wings and a tail. The dashed lines and the overall structure suggest an aircraft. Among the given options, the one that best matches the image is an airplane.

</think>

Answer:

[Correct]

OCR Capabilities Case4



Question: How many times does the character 'e' appear in the picture? Please output the exact number without any additional explanation.

Tiny-R1V-3B Response: <think> I need to count the occurrences of the character 'e' in the given text. I'll go through each character and count how many times 'e' appears. </think>

Answer:

[Correct]

H. Limitations

Due to resource constraints, our experiments are limited to 3B-parameter models. Future work will explore the integration of MLLMs with larger parameter sizes, multilingual support, and a broader range of reasoning tasks. By incorporating more advanced chain-of-thought techniques, such as thinking with images, we aim to enhance its reasoning capabilities on more complex visual-logical reasoning tasks. Additionally, we plan to filter out low-quality samples using rules during the preprocessing stage. For evaluation purposes, we intend to develop new benchmarks specifically designed to assess the reasoning capabilities of MLLMs.

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