# 谷歌BARD的视觉理解能力如何？对开放挑战的实证研究 

秦浩桐 ${ }^{11}$ ，季葛鹏 ${ }^{\dagger}{ }^{2}$ ，Salman Khan ${ }^{3}$ ，范登平 ${ }^{\boxtimes 1}$ ，Fahad Shahbaz Khan ${ }^{3}$ and Luc Van Gool ${ }^{2}$<br>${ }^{1}$ 计算机视觉实验室，苏黎世联邦理工学院，苏黎世，瑞士．<br>${ }^{2}$ 工程计算与控制学院，澳大利亚国立大学，堪培拉，澳大利亚．<br>3 穆罕默德•本•扎耶德人工智能大学，阿布扎比，阿拉伯联合酋长国．


#### Abstract

作为OpenAI公司ChatGPT模型的竞品，谷歌公司提出的BARD模型已经在会话型人工智能领域取得了显著进展。特别值得注意的是，BARD模型的最新版本在对话过程中具备了处理文本提示和视觉输入的能力。鉴于BARD模型在文本输入处理方面取得的令人瞩目成就，本文聚焦于探索其在理解并解析由文本问题引导的视觉数据（图像）方面的潜力。这一探索有望揭示BARD模型以及其他即将涌现的多模态生成式模型背后的新见解与挑战，特别是在解决那些需要准确的视觉和语言理解能力的复杂问题时。具体而言，本研究针对 15 种不同的任务场景展开研究，涵盖了通用，伪装，医疗，水下和遥感数据等领域，用于全面评估BARD模型的表现。实验结果表明，在这些视觉场景中，BARD模型仍然面临一定的困难，表明其在视觉理解能力方面具有提升空间。这项实证研究有助于推动未来相关模型的发展，增强模型在理解和解析细粒度视觉数据方面的能力。项目已发布于https：／／github．com／htqin／GoogleBard－VisUnderstand。


## 1 引言

BARD ${ }^{1}$（谷 歌AI聊 天 机 器 人）是 一 款 基于LaMDA模型［2］和后续的PaLM模型［3］的生成式人工智能系统。于2023年3月初步推出，并于 5 月在全球范围内推广开来。该系统能够接受文本提示，并根据这些提示执行多种基于文本的任务，如提供答案，摘要和创作各类文本内容。截至2023年7月13日，谷歌的BARD宣布了一项重大更新 ${ }^{2}$ ，该更新允许用户以图像作为输入，并

[^0]结合文本提示使用。据报道，BARD能够分析视觉内容，提供相应的描述（如图像标题），或者运用视觉信息回答问题。值得关注的是，尽管其他模型如GPT－4［5］声称能够接受并理解图像输入作为提示，但这些模型并未公开使用。
因此，BARD模型为计算机视觉领域提供了首个机会，去评估它的可靠性和鲁棒性，以理解现有的优势和局限性。本研究工作的目标是基于计算机视觉领域中长期存在的一些问题，分析了BARD模型在应对这类问题上所具备的能力。

本研究针对计算机视觉问题，确定了一系列具有趣味性的任务场景用于BARD模型的定性评价。考虑到当前BARD模型尚未提供开放的API访问权限，因此无法进行大规模基准的


Fig． 1 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从Microsoft COCO数据集［1］中获取的图像回答用户的问题。在接下来的图中，除非另有说明，否则括号中提供了预期的标准答案。有关详细信息，请参阅 第2．1节，第2．2节，第2．3节，第2．4节，第2．5节和 第2．11节。


Fig． 2 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从Tiny－ImageNet－C数据集［1］中获取的图像回答用户的问题。有关详细信息，请参阅 第 2.6 节。

定量测试。这些任务场景和提示不仅适用于评估BARD模型的视觉理解能力，也可以为未来的大规模多模态模型（例如GPT－4）的评估提供一定的参考依据。本研究特别选用BARD模型的原因是，其在所有开／闭源多模态对话模型中表现突出，包括于2023年7月18日推出的Bing－Chat模型［6］。相关数据请参考LLaVA－Bench［7］。

## 2 实证实验

为了评估BARD在给定文本提示的条件下的视觉感知和语境理解等能力，我们设计了一系列视觉－语言任务场景。随后，我们深入研究了从这些实证研究中提取出的若干例子，涵盖了总共 15 个视觉问答（VQA）场景，涉及对象检测和定位，分析对象属性，计数，可供性以及自然图像中的细粒度识别等任务。我们还在一些具有挑战性的情况下进行了实验，例如识别伪装对象，以及医

疗，水下和遥感图像等多样的领域。以下我们对这些场景进行解释。

## 2.1 场景\＃1－对象属性

理解图像中对象的属性和特征是视觉问答中的一项基本任务。例如，在图1的第四个问题中，当给出查询＂镜子的形状是什么？＂时，BARD无法理解镜子这一对象的与形状相关的属性，并且在想象中还出现了镜子中的反射。这表明BARD在识别需要深入理解每个对象及其属性的属性方面存在挑战。

## 2.2 场景 $\# 2-$ 对象存在

这评估了 BARD根据提供的文本描述识别特定对象的能力。正如图1中的第一个问题所证明的，BARD无法正确回答问题＂图像中是否有人出现？＂并提供了错误的回答：＂图像中没有人＂。这表明BARD对视觉内容的基本理解仍然有限。我们进一步注意到，BARD目前适用于不包含任何人类的图像，并会删除包含人脸或人物的任何视觉输入。

## 2.3 场景 $\# 3$－对象位置

该任务场景考察了 BARD 在定位和理解图像内对象方面的能力。例如，参考图1中的第二个问题，询问：＂这张图像中的门在哪里？＂然而，BARD无法在提供的图像中识别出门，回答：＂你发给我的图像中没有门。＂因此，这表明BARD在视觉背景的定位能力方面有待进一步提升。

## 2.4 场景 $\# 4$－关系推理

这个场景评估了 BARD 在理解图像内复杂的对象间动态关系方面的能力，审视其对空间和语义关系的理解。如图1中的最后一个问题所示，我们向BARD提问：＂狗是否靠近电视？＂然而，它未

能提供正确的反馈，回答：＂不，你发给我的图像中狗不在电视旁边。＂因此，这表明BARD在推理关系方面还有提升的空间。

## 2.5 场景\＃5－适用性

适用性测试用于验证BARD在对象可能提供或支持的潜在用途或行动方面的理解能力。这涉及模型对功能的理解，超越了简单的对象识别。图1中的第五个问题＂你可以在哪里躺下睡觉？＂是一个示例研究。有趣的是，BARD可以提供两个合理的答案（即地毯和沙发），但对于其他选项，如一些缺失的项目，如＂卧室里的床。＂和＂海滩。公园。森林。＂，却无法始终如一地提供正确的回答。输出中的错觉意味着BARD仍然需要更好地根据文本指导严格捕捉视觉语义，并将这些语义更有效地与场景中的已识别对象关联起来。

## 2.6 场景 $\# 6$－对抗样本

对抗样本是指经过精心设计的输入，旨在混淆或误导AI模型。由于像素值的微小变化，这些输入对人类来说仍然是可感知的，但对AI模型来说却变得难以解释。在黑盒设置中探索BARD对这些样本的响应至关重要，因为它提供了模型的鲁棒性和稳定性的衡量标准。如图2所示，我们提供了四组图像－文本对，其中图像显示了一些鱼。所有来自BARD的输出都表明它无法理解对抗性样本。

## 2.7 场景 $\# 7$－雨天条件

不同的天气条件在评估模型处理意外情况和领域转变的能力方面起着关键作用，这是现实世界应用的重要前提。因此，我们选择了四组样本，在自然环境中测试 BARD 在不同天气条件下的表现，如图3所示的雨天。结果表明，BARD在图像具有雨天条件时表现不佳。


Fig． 3 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从MPID数据集［8］获取的图像回答用户的问题。有关详细信息，请参阅 第 2.7 节。


Fig． 4 使用谷歌的 BARD进行多模态交互会话的若干示例，其中 AI系统根据从图像情感数据集［9］获取的图像回答用户的问题。有关详细信息，请参阅 第 2.8 节。

## 2.8 场景 $\# 8-$ 情感理解

这个场景评估了BARD理解图像中场景情感或情绪背景的能力，从而考察其对视觉数据更抽象，不可触摸的方面的理解。如图4所示，当我们向BARD提问：＂图像中表达的情感是积极的还是消极的？＂时，它回答了错误的回答：＂图像中表达的情感是消极的。＂

## 2.9 场景 $\# 9$－细粒度识别

这个任务涉及识别给定对象类别中的特定子类别，比一般的对象识别更复杂，因为它涉及到类内变化的增加，类间微小差异的增多，以及对专业领域知识的需求。我们在图5中展示了四种类型的飞机，并向BARD提问以下问题：＂这架飞机的家族，制造商和型号是什么？＂例如，在子图
（a）中，BARD错误地将该飞机识别为波音 $747-$ 400，但它实际上是由空中客车制造，属于A310家族。

### 2.10 场景 $\# 10$－识别伪装对象

这个具有挑战性的任务侧重于识别有意与周围环境融合的隐蔽对象，使它们难以被识别。我们从常用的COD10K数据集 ${ }^{3}$［10］中选择了四个样本。例如，如图6（a）所示，当我们要求BARD识别一条鱼时，它断言：＂我可以自信地说，这张图像中没有动物。＂这一观察表明，BARD在区分伪装对象与周围环境方面存在挑战，特别是当前景和背景具有类似的颜色时。这表明BARD解析伪装模式和类似纹理的能力可以进一步增强。

### 2.11 场景\＃11－对象计数

这个场景测试了模型识别和计数给定文本描述中特定对象的能力。它要求BARD识别对象并对其进行数量化，以探究其在视觉背景下的数值理解能力。如图1所示，我们从数据集中选择了样本，问题是＂地毯图案中有多少个正方

[^1]
＂$X$ The aircraft in the image is a Boeing 747－400．It is a wide－body，four－engine
airliner manufactured by Boeing Commercial Airplanes．The 747－400 is the most airliner manufactured by Boeing Commercial Airplanes．The 747－400 is the most heaviest passenger aircraft in the world．The 747－400 is powered by four General Electric GE－CF6－80C2BIF engines，and it has a maximum range of 7，000 nautical miles．It can carry up to 416 passengers in a two－class configuration．The $747-400$ ha． been used by a number of airlines，including Brititsh Airwayss．Lufthansa，and Qantas． The specific aircraft in the image is a Boeing 747－400 operated by Dinar Lineas Aéreas．It is registered as YV－308C．The aircraft was delivered to Dinar in 2000，and is currently based at Simón Bolivar International Airport in Caracas，Venezuela．＂ ＂X The aircraft in the image is a Boeing 707－328C，which is a cargo variant of the Boeing 707．It is a wide－body，four－engine jet airliner manufactured by Boeing Commercial Airplanes．The $707-328 \mathrm{C}$ was introduced in 1971，and it is the most
common variant of the $707-300$ family．The 707－328C is powered by four Pratt \＆ common variant of the $707-300$ family．The $707-328$ i is powered by four Pratt \＆
Whitney JT3D－7 engines，and it has a maximum range of 3，900 nautical miles．It ca Whitney JT3D－7 engines，and it has a maximum range of 3，900 nautical miles．It can
i carry up to II2，600 pounds of cargo．The specific aircraft in the image is a Boeing carry up to II2，600 pounds of cargo．The specific aircraft in the image is a Boeing
$707-328$ operated by Air France Cargo．It is registereas $F$－BLCC．The aircraft was delivered to Air France in 1978，and it is currently based at Charles de Gaulle Airport in Paris，France．Here is a table summarizing the information about the aircraft in th image：Family Manufacturer Variant Registration Boeing 707 Boeing $707-328$ C
BLCC Wide－body Cargo I12，600 pounds 4 Pratt \＆Whitney JT3D－7 engines 3，900 nautical miles 1978 Air France Cargo Charles de Gaulle Airport，Paris，France Export to Sheets I hope this answers your question！＂＇

（b）What is the family， manufacturer，and varian of this aircraft？（family A300，manufacturer Airbus variant A30084）

（d）What is the family， of this aircraft？（famil BAE 146，manufacturer British Aerospace，varian BAE 146－200）
＂$X$ The aircraft in the image is an Airbus A310－300，which is a wide－body，long－ range commercial airliner manufactured by Airbus．It is the stretched version of the The A310－300 is powered by two General Electric CF6－80C2A8 engines，and it has a maximum range of 7,400 nautical miles．It can carry up to 220 passengers in a two－ class configuration．The specific aircraft in the image is an Airbus A310－300 operated by Mahan Air：It is registered as EP－MHH．The aircraft was delivered to Mahan in 2002，and it is currently based at Mehrabad International Airport in Tehran，Iran． Here is a table summarizing the information about the aircraft in the image：［．．．］ Export to Sheets I hope this answers your question！＇
＂$\checkmark$ The aircraft in the image is a British Aerospace 146，which is a regional iet aircraft that was introduced in 1983．X The specific ais a twin－turbofan，short－range aircraft that was introduced in 1983．X The specific aircraft in the image is a British $\frac{\text { Aerospace } 146-300, \text { which is the most common variant of the } 146 \text { famil．} 1 \text { it is powered }}{\text { by two Rolls－Royce RB．} 183 \text { Mk } 515 \text { turbofan engines，and it has a maximum range of }}$ 1，500 nautical miles．It can carry up to 117 passengers in a single－class configuration．The aircraft in the image is operated by Brussels Airlines．It is registered as OO－DWH．The aircraft was delivered to Brussels Airlines in 1994，and it is currently based at Brussels Airport in Brussels，Belgium．Here is a table summarizing the information about the aircraft in the image：［．．．］Export to Sheets $I$ ＇hope this answers your question！＇

Fig． 5 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从FGVC数据集［11］获取的图像回答用户的问题。有关详细信息，请参阅 第 2.9 节。

a）Is there any animal in this image？（Fish）

（c）Is there any animal in this image？（Bug）
＂X I cannot see any animals in the image you sent me．The image shows a worm－like creature sitting on top of a pile of rocks．The creature has a long，thin body and a striped pattern It is not clear what type of creature this is，but it is not an animal．Animals are multicellular，eukaryotic organisms that can move independently．The creature in the image does not meet these criteria．Therefore，X I can confidently say that there is no animal in this image．Do you have any other questions about the image？＂
＂X Based on the image you sent me，there is no animal in the image．The image shows a close－up of the bark of a tree．The bark is textured and has a variety of colors，but there are no animals visible in the image．The image does contain the text＂John Jeffery：2018＂ which suggests that the image was taken by John Jeffery in 2018. The image is also tagged with the hashtags \＃treebark，\＃nature，and \＃photography．Therefore，X I can confidently say that there is no animal in the image you sent me．The image is simply a close－up of the bark of a tree．＂

（b）Is there any animal in this image？（GhostPipefish）

d）Is there any animal this image？（Snake）

Based on the image you sent me，X I can say that there is no animal in the image．The image shows a coral reef，and there are no animals visible in the image．However，the image does contain regions of seahorses，which are animals．Seahorses are small，fish－like creatures that are found in tropical and subtropical waters．They are known for their long snouts and their ability to swim upright．The image you sent me is a close－up of a coral reef，and it is possible that there are seahorses hiding in the coral．However，the image is not clear enough to see any animals．Therefore，I can confidently say that there is no animal in the image you sent me．However，X it is possible that there are seahorses hiding in the coral．＂
＂$\times$ No，there is no animal in the image you sent me．The image shows a lawn with a lot of dead grass．There are no animals visible in the image，and there are no shadows or other indications that there are animals present． The image is likely an optical illusion，designed to trick the viewer into thinking that there is a snake hidden in the grass．The illusion is created by the way the dead grass is arranged．The grass is arranged in a way that it resembles the outline of a snake．X However，there is no actual snake in the image．The image is a popular optical illusion，and it has been shared online many times．The illusion is often used as a challenge to see if people can spot the snake．$X$ However，the snake is not actually there，and it is impossible to see it．Do you have any other questions about the image？＂

Fig． 6 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从COD10K数据集［10］获取的图像回答用户的问题。有关详细信息，请参阅 第 2.10 节。

（c）How many fish are in
this image？（257）
－X I can＇t tell how many fish are in the picture you sent me．The image is too blurry to see the individual fish．I can see a few shapes that could be fish，but I can＇t tell for sure．If you could send me a clearer image，I might be able to count the fish However，even with a clearer image，it would be difficult to count the fish accurately．There are so many fish in the picture and they are all swimming around，so it would be easy to miss one or two．I hope you can send me a clearer image so that I can count the fish for you．＂

X It is difficult to say how many fish are in the image you sent me．The image is a wide shot of a coral reef，and there are many fish swimming around．It would be very time－consuming to count all of the fish in the image，and it is likely that I would miss some．$\checkmark$ However：I can estimate that there are at least 50 fish in the image． There are many different species of fish in the image，including clownfish，angelfish，butterflyfish，and tangs．The fish are all different sizes and colors，and they are swimming in a variety of patterns．The image is a beautiful depiction of a coral reef，and it is clear that there is a lot of biodiversity in the image．However，it is difficult to say for sure how many fish are in the image．＂

（b）How many fish are in
this image？（143）

（d）How many fish are in
this image？（94）
＂$X$ There is only 1 fish in the picture you sent me．The fish is a clownfish，and it is likely a Nemo．Clownfish are a type of fish that are found in the coral reefs of the Indo－Pacific region．They are known for their bright orange and white coloration，and their symbiotic relationship with sea anemones．The fish in the picture is swimming in front of a coral reef．The coral reef is a beautiful blue color，and it is covered in colorful fish．The fish in the picture is the only clownfish in the image．

## ＂X It is difficult to say for sure how many fish are in the image you sent

 me．The image is a close－up of a coral reef，and there are many fish swimming around．It would be very time－consuming to count all of the fish in the image，and it is likely that I would miss some．$\checkmark$ However：I can estimate that there are at least 10 fish in the image．There are many different species of fish in the image，including clownfish，angelfish，butterflyfish，and tangs．The fish are all different sizes and colors，and they are swimming in a variety of patterns．The image is a beautiful depiction of a coral reef，and it is clear that there is a lot of biodiversity in the image．However，it is difficult to say for sure how many fish are in the image．I hope this helps！＇Fig． 7 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从IOCfish5K数据集［12］获取的图像回答用户的问题。有关详细信息，请参阅 第2．11节。

形？＂BARD给出了错误的计数，因为它错误地将地毯的长度和宽度间隔误认为是一个 $14 \times 14$ 的

网格。有趣的是，人类可能会通过将多个子正方形组装成一个较大的正方形来巧妙地解决这

＂Based on the image you sent me，$X$ there are no defective regions in the image．The image shows a black and white photo of a wall，and the wall appears to be smooth and uniform．$X$ There are no cracks， pits，or other defects that I can see．The image is a bit blurry，so it i． possible that there are some small defects that I am not able to see． However，based on the image quality，I do not believe that there are any major defects．I can see that the wall is made of concrete，and concrete walls are typically very smooth and uniform．$X$ They do not often have defects，but there are some types of defects that can occur， such as cracks，pits，and spalling．X Based on the image you sent me，I do not see any obvious defects．However，if you are concerned about the quality of the wall，you may want to have it inspected by a professional．Do you have any other questions for me？＂
＂X I do not see any defective regions in the image you sent me． The image shows a close－up of a checkered fabric，and the fabric appears to be smooth and uniform．The checkerboard pattern is clear and consistent，and there are no loose threads，stains，or tears．The image is a bit blurry，so it is possible that there are some small defects that I am not able to see．However，based on the image quality，X I do not believe that there are any major defects．Therefore，my answer to your question is No，there is no defective region in the image you sent me．＂

＂According to the image you sent me，$X$ there are no defective regions in the image．The image shows a close－up of a metal object on a black background． The object is smooth and uniform，and $X$ there are no cracks，pits，or other defects that I can see．The image is a bit blurry，so it is possible that there are some small defects that I am not able to see．However，based on the image quality，XIdo not believe that there are any major defects．The image you sent me is a stock photo of a metal nut．Nuts are typically very smooth and uniform，and they do not often have defects．However，there are some types of defects that can occur on nuts，such as cracks，pits，and rust．$\times$ Based on the image you sent me，I do not see any obvious defects．However，if you are concerned about the quality of the nut，you may want to have it inspected by a professional．Therefore，my answer to your question is No，there is no defective region in the image you sent me．
＂X I cannot see any defective regions in the image you sent me．The image shows a close－up of a piece of wood，and the wood appears to be smooth and uniform．There are no cracks，pits，or other defects that I can see．I can see that the wood is a light brown color，and it has a straight grain．The grain is evenly spaced，and $X$ there are no knots or other defects．The image is a bit blurry，so it is possible that there are some small defects that I am not able to see．X However，based on the image quality，I do not believe that there are any major defects．Therefore，my answer to your question is No，there is no defective region in the image you sent me．＂

Fig． 8 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从CDS2K数据集［13］获取的图像回答用户的问题。有关详细信息，请参阅 第 2.12 节。


Fig． 9 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从TextVQA数据集［14］获取的图像回答用户的问题。有关详细信息，请参阅 第 2.13 节。

个问题，而不是直接数最小的单位，这似乎超出了BARD的能力。

此外，我们还对探索BARD在更具挑战性的任务上的表现很感兴趣，即计算伪装对象的数量。我们随机选择了四张图像，如图 7所示，来自IOCfish5K ${ }^{4}[12]$ 。该数据集包括充满难以辨认的海洋生物的大规模水下图像，由于能见度有限和主动模仿，这些生物很难计数。从我们的实证研究观察到，BARD在描述场景方面表现出色，例如在子图（a）中：＂图像是一个珊瑚礁的广角

[^2]镜头，周围有很多鱼在游动。＂然而，在理解挑战性场景中的高层次内容方面，BARD似乎不够熟练，回答＂很难说图像中有多少条鱼。＂

### 2.12 场景 $\# 12$－发现工业缺陷

质量检验在制造业中扮演着至关重要的角色，保障产品质量和维持高效运营。我们的目标是调查BARD在识别工业材料中伪装的缺陷，异常或不规则性方面的能力。为此，我们从一个伪装缺陷分割数据集 $\mathrm{CDS}^{2} \mathrm{~K}^{5}$［13］中随机选择了一些有

[^3]缺陷的样本。如图 8所示，这些样本包括：（a）磁砖上的气孔，（b）地毯上的油渍，（c）金属螺母上的凹痕，以及（d）木质材料上的一对孔洞。在与BARD进行交互时，我们提供了问题提示：＂图像中是否有任何有缺陷的区域？＂生成的回答出现在对话界面上。我们观察到BARD在识别这些在挑战性场景中不易察觉的缺陷方面遇到困难，因此向用户提供了错误的回答。

### 2.13 场景\＃13－识别光学字符

BARD能否识别和理解图像中包含的＂文本＂，例如扫描文档中的文本？为了回答这个问题，我们使用了一个光学字符识别数据集 $\mathrm{TextVQA}^{6}$［14］，以基于图像中的文本来评估BARD的视觉推理能力。如图9（d）所示，BARD在各种文本识别场景中遇到了困难：在表面上很明显的问题＂这个地点的名称是什么？＂下，它错误地回答了＂我只是一个语言模型，所以无法帮助您。＂，这显示出模型难以理解自然图像中的文本。

### 2.14 场景 $\# 14$－分析医疗数据

与自然场景不同，医疗数据包含复杂的与健康相关的信息，需要临床，解剖和病理专业知识来进行正确解释。因此，一个有趣的问题是调查BARD在医疗影像数据集中的能力程度。为了评估BARD的能力，我们从结肠镜检查数据集SUN－SEG ${ }^{7}$［15］中挑选出了四幅息肉（阳性）图像。然而，如图10所示，前三幅图像没有输出有意义的内容，而最后一幅图像中的息肉识别失败。我们在其他医学图像模态，如X射线片，MRI，CT扫描和皮肤病变图像上也遇到了类似的输出。

[^4]
### 2.15 场景\＃15－解释遥感数据

为了与BARD进行交互，我们使用了来自 RSVQA－LR ${ }^{8}$［16］的各种图像－文本对，这是一个用于遥感视觉问答任务的精心构建的数据集。其目标是通过以自然语言表达的直观问题进行交流，简化广大受众对地球观测数据中信息的访问。例如，如图11（a）所示，提出了问题：＂图像中有多少座商业建筑物？＂BARD的回答是：＂图像中有一座商业建筑物。＂，这与正确答案 82 显著不同。我们的发现表明，BARD在整体上理解视觉场景的趋势，但在识别细粒度的视觉模式方面面临挑战，特别是在确定对象的精确数量，如这种情况下的商业建筑物。

## 3 结语

谷歌的BARD在会话型人工智能领域的出现引起了极大的关注，因为它取得了显著的成功。在此势头的基础上，我们的研究旨在全面评估BARD在各种任务场景下的表现，包括常规，伪装，医疗，水下和遥感图像。我们的调查显示，虽然BARD在许多领域表现出色，但在某些基于视觉的情景中仍面临挑战。这一发现凸显了 BARD在各种应用中的巨大潜力，并强调了在视觉相关任务中增长和改进的充足空间。我们研究的实证见解预计对未来模型的发展具有价值，特别是在弥合视觉性能差距方面。通过解决视觉情景中观察到的局限性，我们预计后续模型将具备更强的视觉理解能力，最终推动会话型人工智能的发展达到新的高度。

[^5]

Fig． 10 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从SUN－SEG数据集［15］获取的图像回答用户的问题。有关详细信息，请参阅 第2．14节。


Fig． 11 使用谷歌的BARD进行多模态交互会话的若干示例，其中AI系统根据从RAVQA－LR数据集［16］获取的图像回答用户的问题。有关详细信息，请参阅 第2．15节。

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[^1]:    ${ }^{3}$ https：／／github．com／GewelsJI／SINet－V2

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