embedded® VISION ALLIANCE

TOOLS & PROCESSORS FOR COMPUTER VISION

Selected Results from the Embedded Vision Alliance's Computer Vision Developer Survey

JANUARY 2019

EXECUTIVE SUMMARY

Since 2015, the Embedded Vision Alliance® has surveyed computer vision developers regarding the products they are working on and the hardware and software tools they are using in their projects.

This white paper provides selected results from our most recent survey, conducted in November 2018. We received responses from 692 computer vision developers across a wide range of industries, organizations, geographical locations and job types. We have focused our analysis on the 345 respondents whose organizations are developing end products for consumers, businesses or governments (vs. organizations that are providing services, or providing components, subsystems or software for incorporation into new products).

We hope these selected results provide insight into the popular hardware and software platforms being used today for vision-enabled end products.

Full survey results are available for Embedded Vision Alliance member companies. Please email info@embedded-vision.com for more information.

Note: Percentages add up to more than 100% in many of the charts presented in this white paper. This is because many of the questions allowed respondents to select more than one option.

The Embedded Vision Summit is the only conference focused on practical computer vision and deep learning for visual AI. Coming up May 18-21, 2020, you'll learn the latest in this rapidly changing field through:

Inspiring keynotes

90+ presentations on **applications, trends, technologies** and **business opportunities** for vision-based products

100+ **demos** from 60+ exhibitors in the Vision Technology Showcase

Hands-on trainings on TensorFlow 2.0 and OpenCV

Full day **Vision Technology Workshops** provided by Alliance Member companies

To register, visit **embedded-vision.com/summit**.

CURRENTLY USING OR PLANNING TO USE COMPUTER VISION IN YOUR PRODUCTS OR SERVICES

November 2018

74% ▲ +3
Currently using

19% ▼ -1
Planning to use

4%
Don't know

3% ▼ -2
Not planning to use
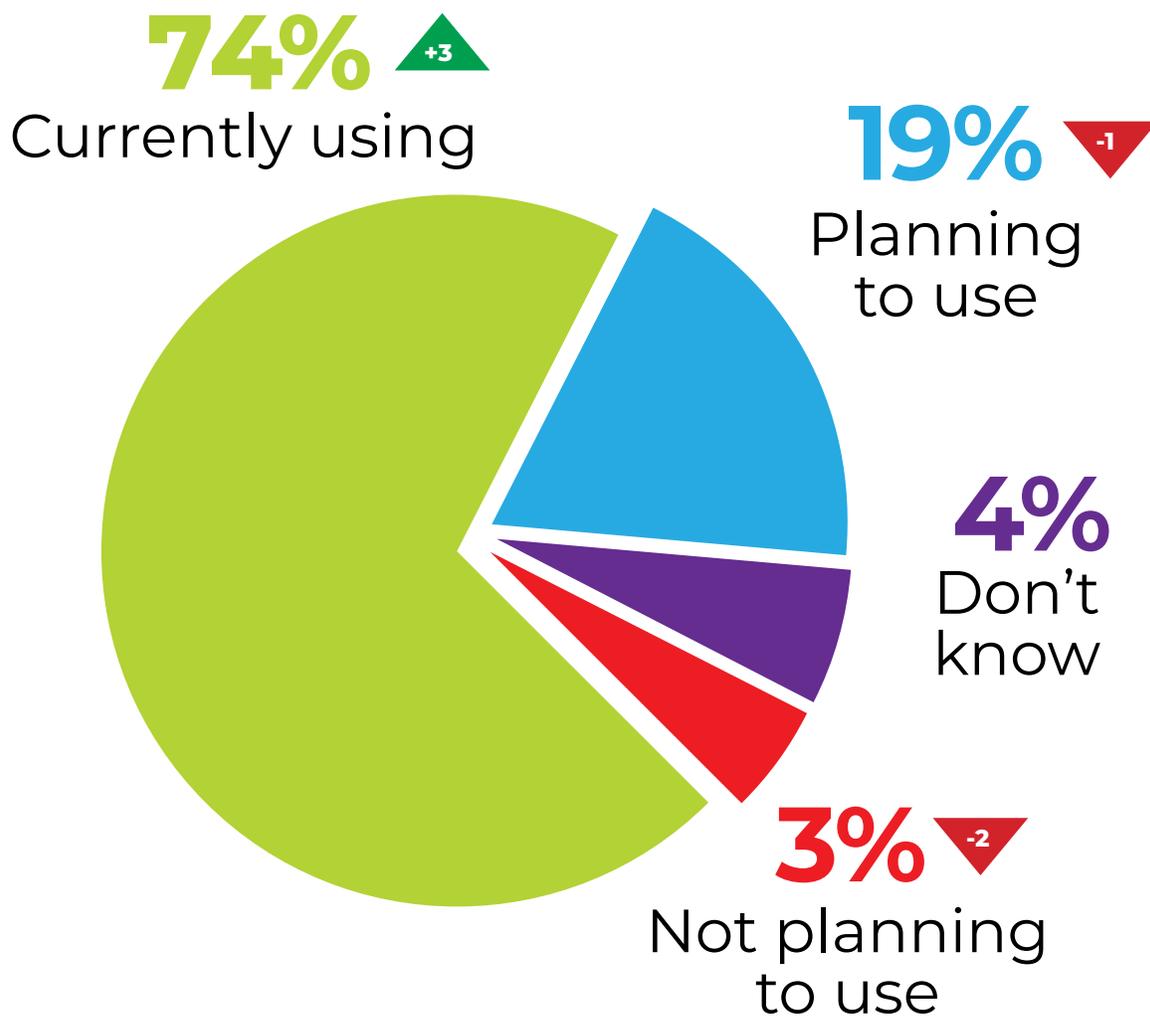
More than 90% of survey respondents are using or planning to use computer vision in their products or services. Similar to our previous surveys, the overwhelming majority of respondents are developing or planning to develop products or services using computer vision.

TYPES OF PROCESSORS USED FOR VISION TASKS

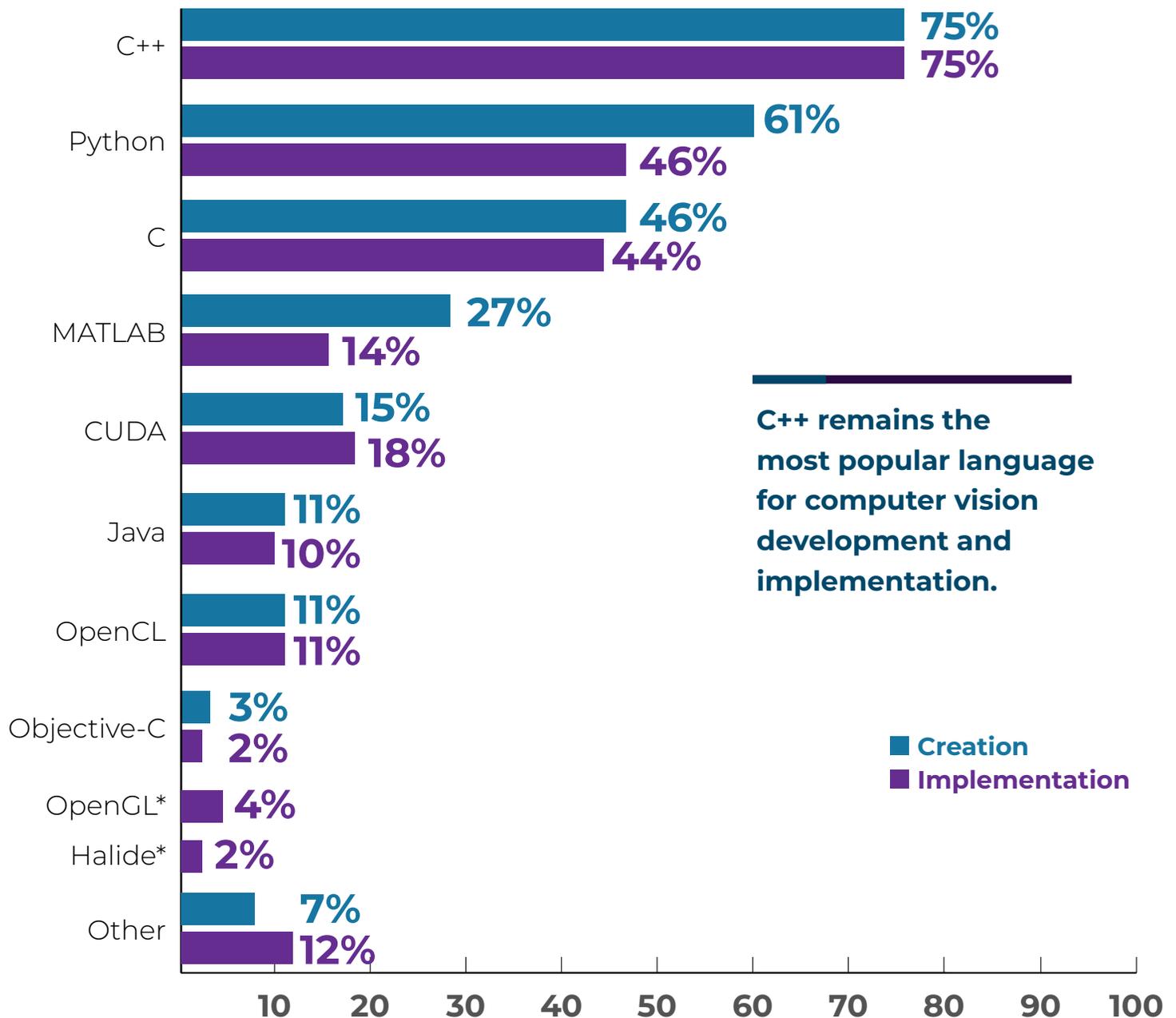## Ranked as One of Top Three

November 2018
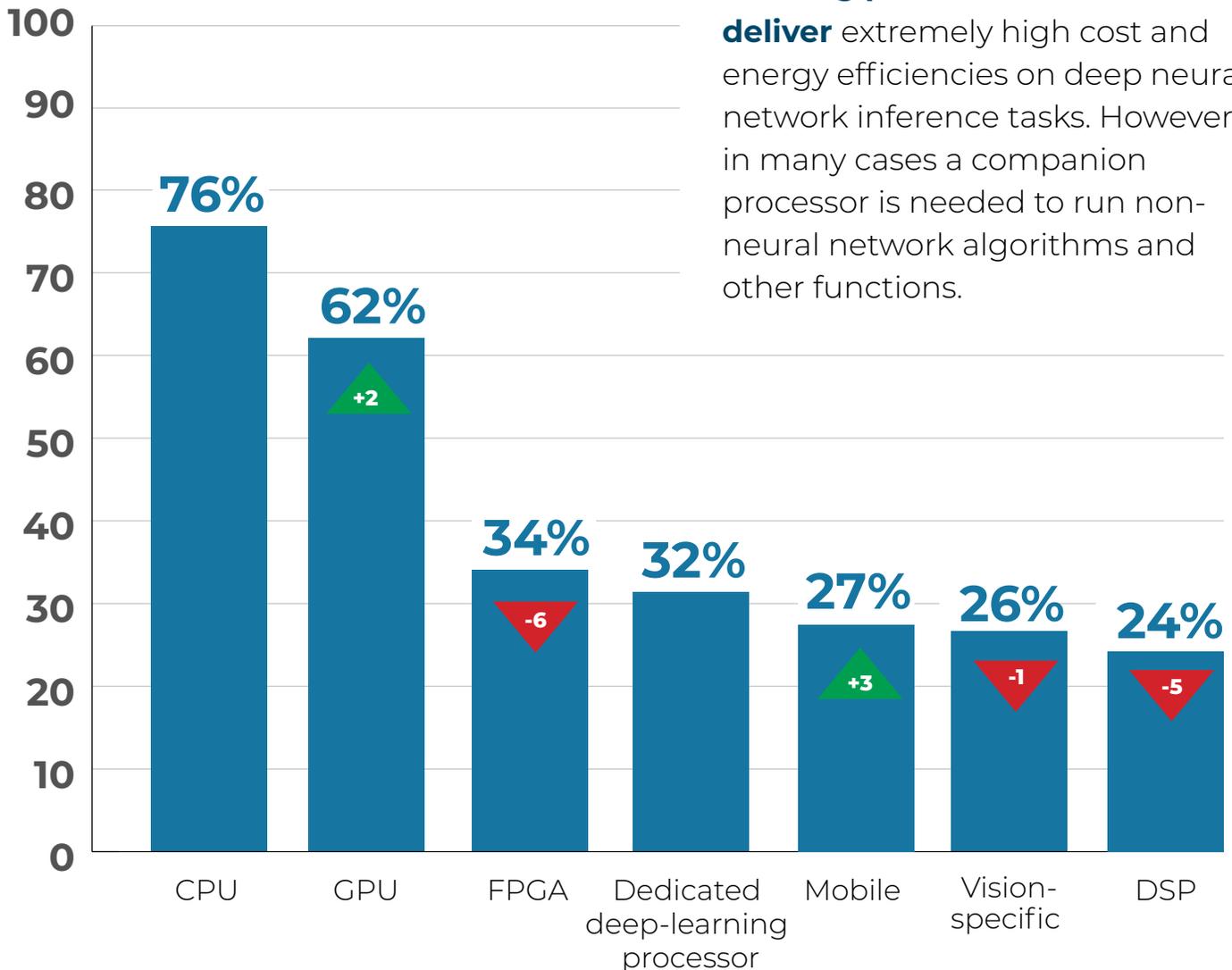
Due to their specialized architectures, dedicated deep learning processors often deliver extremely high cost and energy efficiencies on deep neural network inference tasks. However, in many cases a companion processor is needed to run non-neural network algorithms and other functions.

76%	CPU
62% +2	GPU
34% -6	FPGA
32%	Dedicated deep-learning processor
27% +3	Mobile
26% -1	Vision-specific
24% -5	DSP

PROGRAMMING LANGUAGES USED FOR CREATING AND IMPLEMENTING NON-NEURAL NETWORK VISION ALGORITHMS

Ranked as One of Top Three

November 2018

Language	Creation	Implementation
C++	75%	75%
Python	61%	46%
C	46%	44%
MATLAB	27%	14%
CUDA	15%	18%
Java	11%	10%
OpenCL	11%	11%
Objective-C	3%	2%
OpenGL*		4%
Halide*		2%
Other	7%	12%

C++ remains the most popular language for computer vision development and implementation.
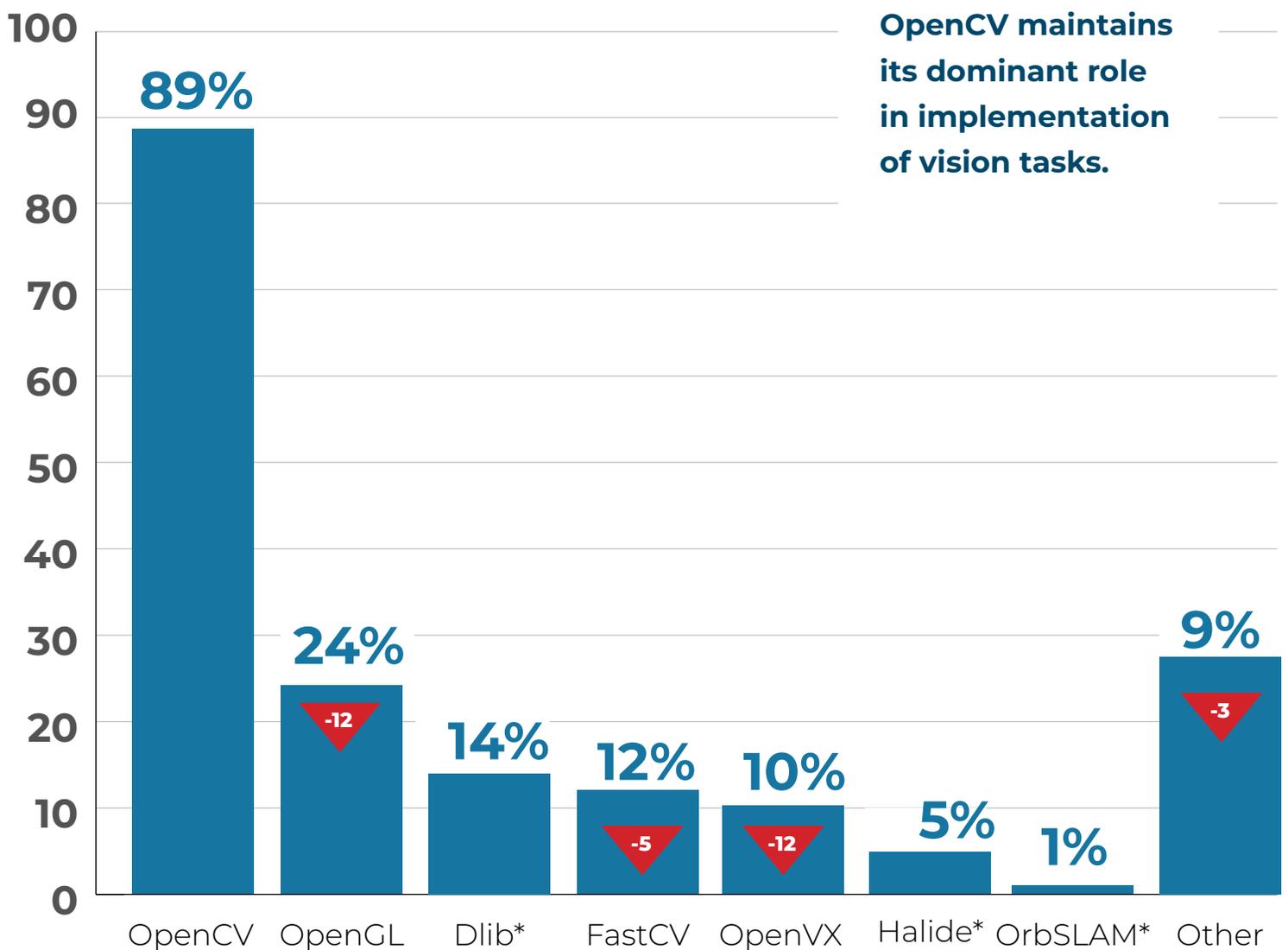
■ Creation
■ Implementation

Note: This question was rephrased for the November 2018 Survey. The current survey asks two separate questions regarding vision algorithms: one about algorithm creation and one about algorithm implementation. Since OpenGL and Halide are generally implementation languages, they were not answer options for the algorithm creation question. This was a sufficiently large change that comparison with answers from our last survey was not meaningful and are thus not shown.

LIBRARIES AND APIs USED FOR IMPLEMENTING NON-NEURAL NETWORK VISION TASKS
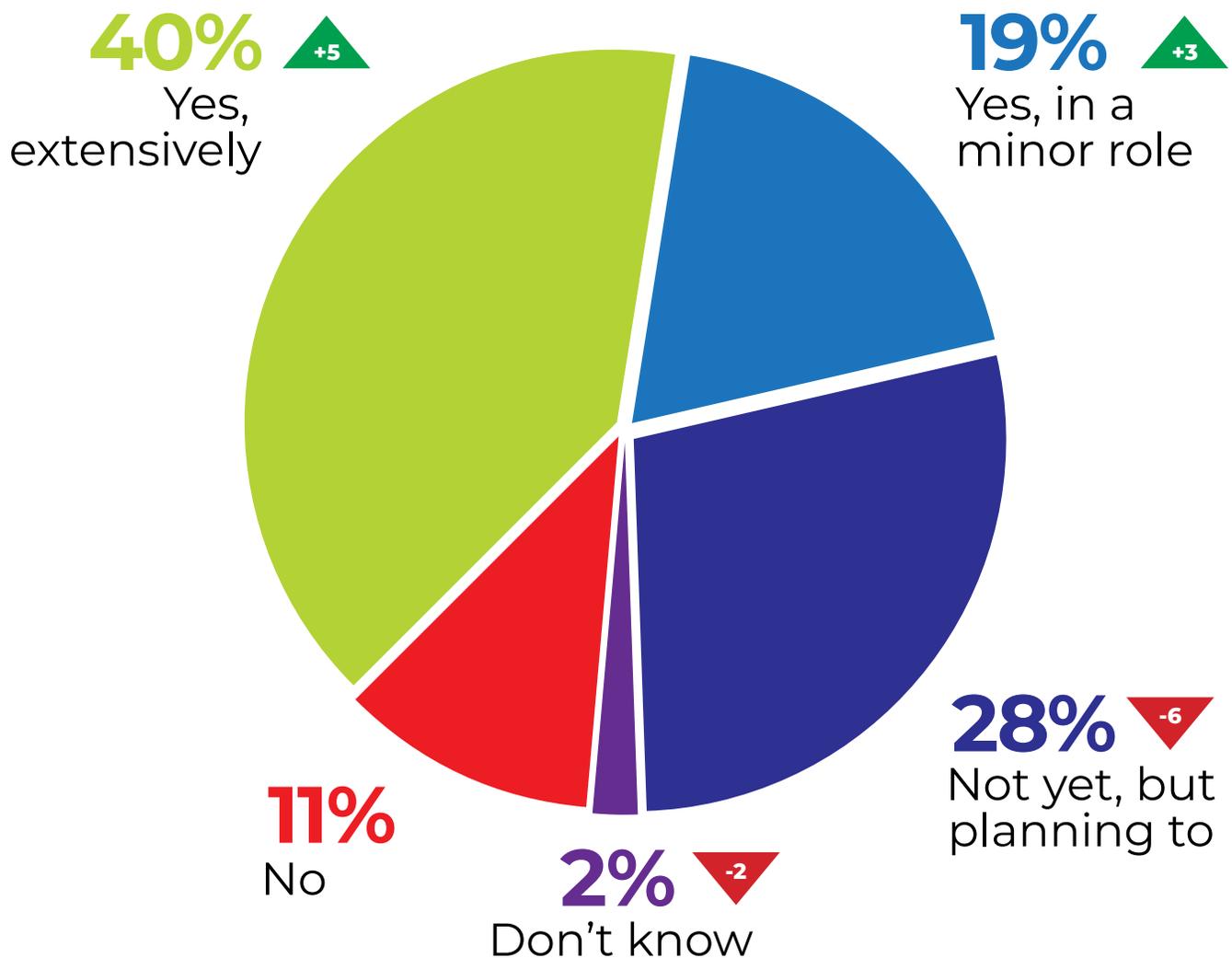
Ranked as One of Top Three

November 2018

OpenCV maintains its dominant role in implementation of vision tasks.

Chart data:
- OpenCV: 89%
- OpenGL: 24% (-12)
- Dlib*: 14%
- FastCV: 12% (-5)
- OpenVX: 10% (-12)
- Halide*: 5%
- OrbSLAM*: 1%
- Other: 9% (-3)

Note: For the November 2018 survey, we added 3 new answer options, marked with an asterisk. This can have a general effect of reducing percentage numbers across older categories.

USE OF NEURAL NETWORKS FOR COMPUTER VISION

November 2018

40% ▲+5
Yes, extensively

19% ▲+3
Yes, in a minor role

28% ▼-6
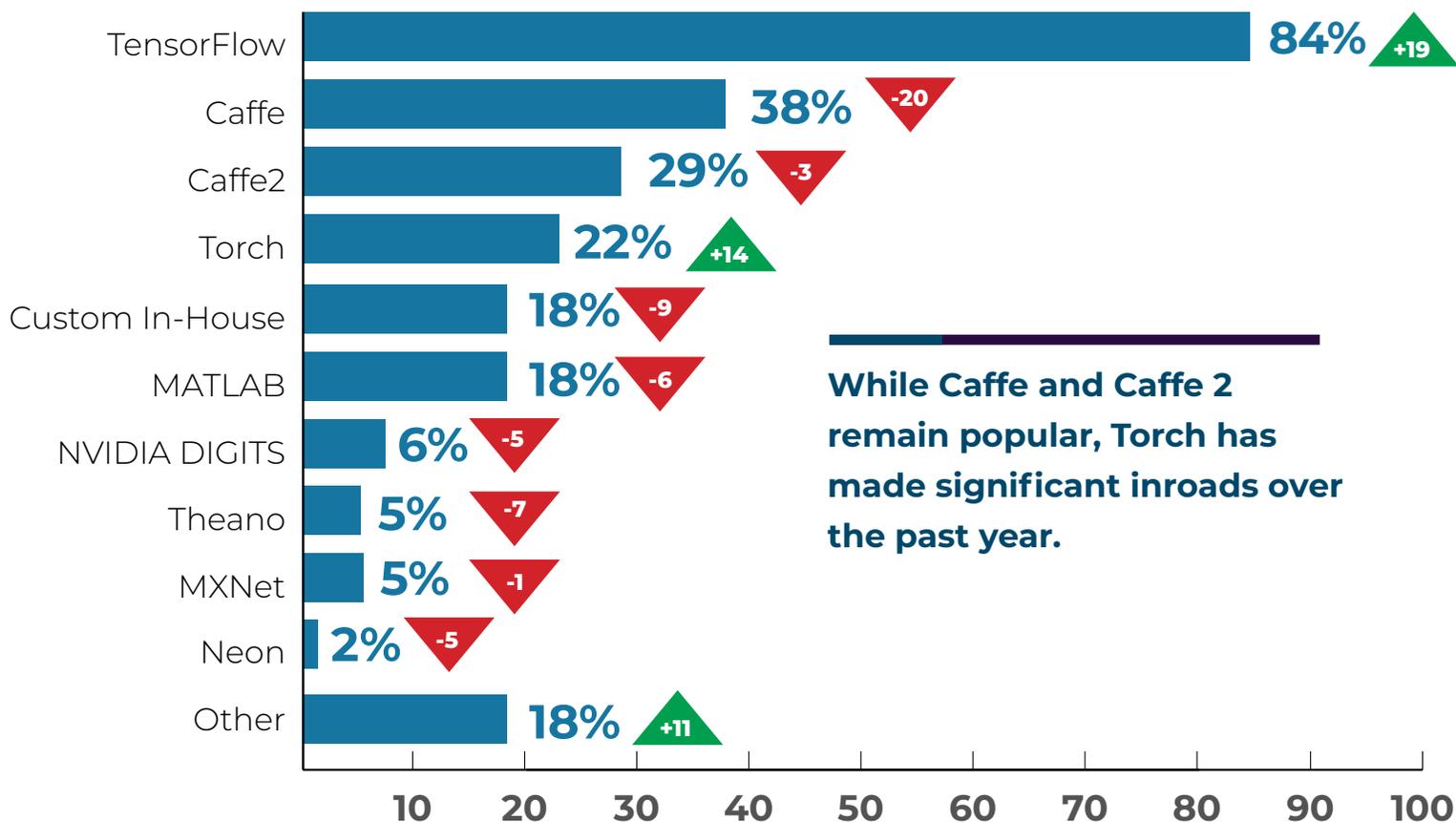Not yet, but planning to

2% ▼-2
Don't know

11%
No

87% of survey respondents use or plan to use neural networks to perform computer vision functions in their products or services. Neural networks continue to be one of the dominant techniques for computer vision.

SOFTWARE USED FOR CREATING, TRAINING OR EVALUATING NEURAL NETWORKS FOR VISION TASKS

Ranked as One of Top Three

November 2018

TensorFlow continues to dominate the field. Google's open-source TensorFlow increased its lead as the most popular deep learning/neural network design framework.
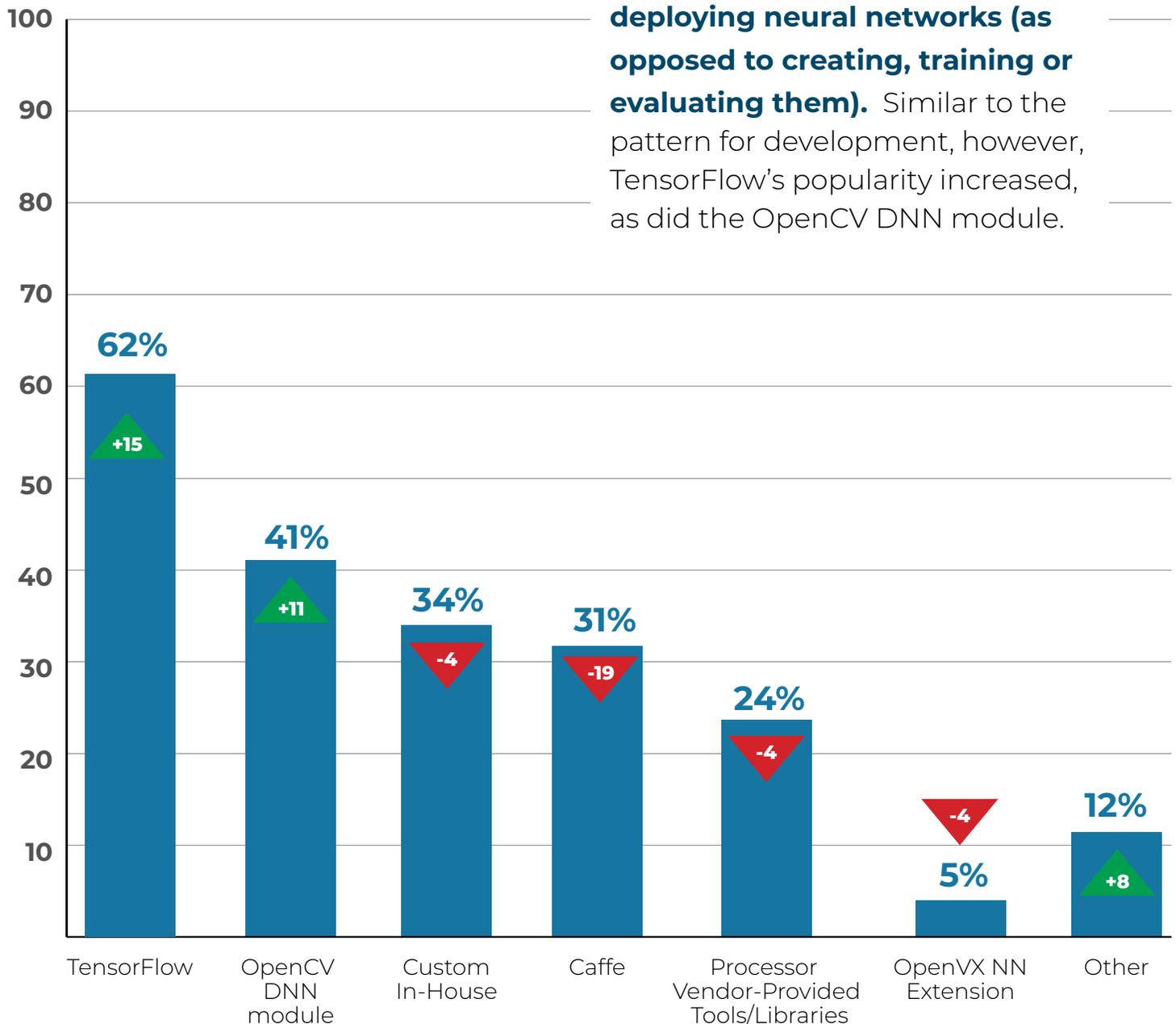

Framework	Value	Change
TensorFlow	84%	+19
Caffe	38%	-20
Caffe2	29%	-3
Torch	22%	+14
Custom In-House	18%	-9
MATLAB	18%	-6
NVIDIA DIGITS	6%	-5
Theano	5%	-7
MXNet	5%	-1
Neon	2%	-5
Other	18%	+11

While Caffe and Caffe 2 remain popular, Torch has made significant inroads over the past year.

SOFTWARE USED FOR DEPLOYING NEURAL NETWORKS FOR VISION TASKS

Ranked as One of Top Three

November 2018

Approaches continue to vary for deploying neural networks (as opposed to creating, training or evaluating them). Similar to the pattern for development, however, TensorFlow's popularity increased, as did the OpenCV DNN module.

Chart data:

Software	Percentage	Change
TensorFlow	62%	+15
OpenCV DNN module	41%	+11
Custom In-House	34%	-4
Caffe	31%	-19
Processor Vendor-Provided Tools/Libraries	24%	-4
OpenVX NN Extension	5%	-4
Other	12%	+8

ALLIANCE PROGRAMS

VISION ACCELERATOR PROGRAM

The **Vision Accelerator Program** helps companies quickly understand and navigate the technical and business complexity of incorporating visual perception capabilities so they can more quickly and confidently plan, develop and deliver their products. It is a service available to members of the Embedded Vision Alliance who are developing end products and systems with visual perception capabilities (e.g., deep learning, 3D sensing).

The Vision Accelerator Program helps companies:

✓ Make decisions in a fast-changing market where areas like deep learning and 3D sensing are rapidly moving from research into practical use

✓ Understand the tradeoffs for low-power, low-cost devices and cloud processing

✓ Know what vision software standards, open source tools and algorithms are gaining traction

✓ Identify which startups, suppliers, partners and experts have relevant vision technologies and know-how

✓ Build skills and recruit the right talent

✓ Access and develop a network of experts, suppliers and partners

For more information on the Vision Accelerator Program, email **accelerate@embedded-vision.com**

ABOUT THE ALLIANCE

The Embedded Vision Alliance is a global partnership that brings together technology providers with end product and system developers who are enabling innovative, practical applications of computer vision.

Our mission is to inspire and empower product creators to incorporate visual intelligence into new products and applications, and enable member companies to accelerate success in computer vision by:

✓ Bringing together suppliers, end-product designers and partners to speed the adoption of computer vision in products

✓ Delivering timely insights into market research, technology trends, standards and application requirements

✓ Enabling companies to become more visible as thought leaders

For information on joining the Alliance, please visit **www.embedded-vision.com**