To whom it may concern:

I collect and restore vintage computers as a hobby, and have also built and rebuilt gaming PCs for myself and several friends. Word spread among my social groups that I 'like old computers', and over the last several years I have found myself the recipient of over a dozen secondhand desktop and laptop computers. The majority of these machines were between 4 and 8 years old, and still working but running slowly. There are three observations I would like to make about the computers I've been given.

Firstly, when computers of this age have no major problems, it is possible to greatly improve their performance with a few simple and minor upgrades. (Specifically: thorough internal cleaning and replacement of thermal paste to prevent overheating, replacement of storage with faster and higher-capacity options, upgrading RAM, and replacing failing batteries with new ones.) Cleaning and 're-pasting' a computer is effectively free, and other upgrades can be completed for a few hundred dollars at most - less than the cost of a new computer. With some or all of these upgrades, plus a fresh installation of a suitable operating system, a computer that was previously unusably slow can be made suitable for light usage. Activities such as online banking, email, messaging, word processing, listening to music, browsing the Internet, Zoom/Facetime/Skype etc are entirely possible on older computers using free software. The genuine usefulness of such machines has never been as obvious as during the ongoing coronavirus pandemic, when many households that previously needed only 1-2 computers suddenly found they needed one computer per child for online schooling, but with quite minimal hardware and performance requirements for these devices. Other people and organisations who could likely make use of older or underpowered computers include senior citizens, community groups and disadvantaged members of the community.

Secondly, the cost and feasibility of these upgrades depends to a large extent on the design of the device, particularly for laptops. There is nothing inherently difficult about cleaning a laptop internally and replacing parts that have failed or are bottlenecking performance. However, some modern devices are designed to make this unnecessarily complicated. Some devices (notably recent Apple laptops) use non-standard screws, and can only be disassembled for cleaning or repair by someone who has access to specialised screwdrivers[1]. Other devices are held together with hot glue and require even more expensive equipment (heat pads, hot plates or hot-air stations) to disassemble; some must even be cut with blades[2,3,4,5]. In some cases the temperatures needed to release the adhesive will damage or destroy other parts of the device (as demonstrated by iFixit on a Microsoft Surface laptop, the keyboard and case of which melted while iFixit technicians were trying to disassemble the device[6].) In most cases (with the exception of phones which are waterproofed using adhesive) these design choices are not essential to the function, safety or aesthetics of the device, as shown by similar devices which can be disassembled easily and with simple tools[7,8]. They contribute to the perception among members of the public that repairing electronic devices is difficult, and that only manufacturers or professionals should even try, when realistically a motivated person can easily learn to do simple upgrades and repairs using information that is freely available online. In my opinion, usage of non-standard screws and excessive adhesive in device manufacturing is an unnecessary barrier to repair.

Thirdly, the majority of the older computers I have been given were quite literally 'dumped at my doorstep' by people who despaired of throwing them out, but had no idea what to do with them. Some of them are beyond economic repair and need to be recycled. Others are still useful as described above, but no longer suitable for my friends' needs (as university students and gamers tend to have higher hardware requirements.) There is clearly a lack of information within the community about how to responsibly dispose of broken, obsolete or unwanted computers and other electronics. Most of the services that are easily discovered with a Google search offer recycling only (and will not repurpose working computers), many require payment, and accessing free services (such as those

available at council-operated waste transfer stations) usually requires that you have a car to take your e-waste to the collection point. Gumtree, eBay and buy-sell-swap pages on social media are frequently swamped with listings for working or partially working electronics with descriptions like 'please come and take it or I'll have to put it in the bin.' I see a clear need within the community for more organisations that will repair/upgrade and repurpose older working computers as opposed to recycling them, and also for e-waste recycling services that are easier for people without money and transport to access (since these people currently have a financial incentive to simply put their e-waste in the garbage bin.) Perhaps these services could be provided as an adjunct to annual kerbside collection of large waste that occurs yearly in many areas.

Finally, I would like to draw your attention to two issues that have been raised regarding device design and OEM customer service within the online right to repair community. As a hobbyist, I have not had personal experience with these repair issues, as they are beyond the level of technical capability that I have; they have been very well explained by others. Specifically:

1: It is standard for storage in phones and tablets, and increasingly also in laptops, to be integrated into the mainboard. This means that if the board fails, it becomes impossible to access the data saved on the device, and because the storage media cannot be removed and plugged into another device, board repair is the only way to retrieve the data. There are multiple documented examples of manufacturers lying to consumers about the fact that third-party repair businesses provide this service, claiming instead that recovery of the data is impossible and that businesses offering this service are scams[9,10,11]. In my opinion, this is anti-competitive, and causes great harm to consumers who unnecessarily lose their data.

2: When parts are replaced in some recently-released devices, the devices then permanently lose functionality, or show alarming messages to the consumer about how they now contain 'non-genuine' parts. This occurs even when the component is replaced with an identical OEM part (not a third-party manufactured part) because the device is pre-programmed to check component serial numbers[12,13,14,15]. Only the device manufacturer or authorised service provider has access to software which enables replacement of these parts without loss of functionality or generation of alarming messages. In my opinion, this is an unnecessary barrier to repair, and is anti-competitive because third-party repair businesses providing an equal quality of service with equal quality parts are unable to restore the device to full functionality for an arbitrary reason.

I am a strong believer in the democratisation of knowledge, and that almost nothing is too complicated for a motivated hobbyist to learn to do it well. Maintenance and repair of electronics falls firmly into this category. When people are able to upgrade and fix their own devices, either so they can continue to use them or so they can donate them to people in need, the community benefits and less e-waste is created. Thank you for your time and attention to this important issue.

References:

1: Since 2009, many Apple devices (including iPads, Macbooks and iPhones) have used pentalobe screws, which Apple refers to as 'Pentalobe security screws'. What is being secured, and from whom? It is worth noting that these screws are prone to being stripped and are mechanically inferior to other screw designs of comparable size. https://www.ifixit.com/News/9905/bit-history-the-pentalobe

2: Example laptop screen replacement which is difficult and requires specialised tools due to adhesive: Macbook Pro A1278. https://bit.ly/2Mcy1PX

3: Example phone screen replacement which is difficult and requires specialised tools due to adhesive and use of non-standard screws: iPhone 11. https://bit.ly/3agPD54

4: Example phone screen replacement which is difficult and requires specialised tools due to adhesive: Samsung Galaxy S9. https://bit.ly/3r31fPQ

5: Example tablet screen replacement which is difficult and requires specialised tools due to adhesive: iPad Air. https://bit.ly/3cpkKhz

6: Example laptop disassembly which is virtually impossible due to use of adhesive with a higher melt temperature than plastic components of the case: Microsoft Surface Laptop https://bit.ly/36wDCr7

7: Example tablet screen replacement with no adhesive which uses standard tools and parts: Samsung Galaxy Tab 10.1 https://bit.ly/2Yu3rnr

8: Example laptop screen replacement with no adhesive removal or specialised tools: Dell Latitude E6420. https://www.ifixit.com/Guide/Dell+Latitude+E6420+Screen+Replacement/106870

9: CBC News (Canada) report on data recovery: 'Expert disputes Apple on data recovery from water-damaged iPhones.' https://www.youtube.com/watch?v=K98JYRBGyrg

10: iPad Rehab livestream: recovering data from a damaged iPhone. During the stream, accurate information about third-party repair is removed from Apple's discussion boards and replaced with misinformation; the link to the Apple discussion page is in the video description.
https://www.youtube.com/watch?v=tFR43dRFJZ0

11: iPad Rehab video: data recovery from Macbooks complicated by choice of storage technology.
https://www.youtube.com/watch?v=mftBdjwp9Z8

12: Explanation of serialisation of parts by Louis Rossmann using Samsung as an example:
https://www.youtube.com/watch?v=fz2R7-zTdKk

13: Teardown of iPhone 12 by Hugh Jeffreys demonstrating unnecessary barriers to repair:
https://www.youtube.com/watch?v=FY7DtKMBxBw

14: Teardown of Samsung Galaxy A51 by Hugh Jeffreys demonstrating unnecessary barriers to repair:
https://www.youtube.com/watch?v=zGLQ9ZRntZo

15: Example of further serialisation of iPhone 12 by Hugh Jeffreys:
https://www.youtube.com/watch?v=8-FxNKEH_qc